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# The Pennsylvania School Journal

DEVOTED TO SCHOOL AND HOME

## EDUCATION

J. P. WICKERSHAM, EDITOR.

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THE
# SCHOOL JOURNAL
ORGAN OF THE DEPARTMENT OF COMMON SCHOOLS AND OF THE STATE TEACHERS' ASSOCIATION.

Vol. 29. DECEMBER. No. 6.

## THE SPIRIT OF THE NORMAL SCHOOLS.

FROM REPORTS OF PRINCIPALS.

THE paragraphs below are selected from the recent reports of tne Principals of our State Normal schools. They show the spirit of these schools, and will attract, we hope, general attention. The whole teachers' profession, and the friends of education generally, are vitally interested in the work of preparing teachers now in progress.

### THOUGHTS FROM MILLERSVILLE.

The experience of each year impresses me more deeply with the importance of emphasizing the course in professional training. Last year I made it especially prominent, particularly the drill in the application of the principles of the science or art of teaching, and I am pleased to learn that the class showed the fruits of this drill in their practical teaching before the State board of examiners. Your decision to examine the classes in the practice of teaching, has been of great service to me in aiding me to lift into greater prominence the fact that *skillful practice* is to be regarded as one or the principal tests of the qualifications of a normal school graduate. I not only had much greater interest in the subject during the regular class periods, but sub-classes were voluntarily formed to discuss methods, and practice the presentation of difficult points in the various branches. We shall pursue the same methods this year, trying to cover more ground than we did last year, and to attain even better results in the practice of teaching. Our aim is to be *sound in theory* and *skillful in practice*. Teaching is a fine art—it is one of the most beautiful of the arts, and the normal school should aim to turn out *artists in teaching*.

Our normal schools have done a good work in the past, but it seems to me the time is fast approaching when their sphere of usefulness is to be enlarged and elevated. There seems to be a feeling among normal school principals, and other friends of these institutions, that some changes are needed in our normal school policy. The changes indicated respect, particularly, the *course of study*, and the *methods of examination*. To aid in crystallizing this feeling, permit me to repeat my own views, as expressed on several occasions :

1. I think we should add about one year to the present course of study in the elementary course, abolish the scientific and classical courses, as now provided by law, and regard this one course as the normal school course. The nature of this course I stated in my report of 1878; it is identical with the so-called "advanced course," recommended for your consideration by the committee of normal school principals appointed to prepare a curriculum of studies for our normal schools.

2. If this course were adopted, I recommend that there be an examination by the State board at the end of the junior year, as well as at the end of the senior year. Those who pass the examination in the junior studies might be licensed to teach, say for two or three years, and be known as *licentiates* in distinction from the *graduates* of these schools. The graduates of these schools would then be educated to that extent that they could make an unquestioned claim to qualifications entitling them to constitute a *profession of teaching*, which is not now allowed by the educational public. Such a change would do much to elevate both our normal schools and the avocation of teaching, and eventually the system of popular education throughout the Commonwealth. From the necessities of the case, as well as the general feeling among normal school men, I am convinced that changes in this direction are only a matter of time ; and I am anxious to hasten the time so that I may enjoy some of the fruits of change before I transfer my work to younger hands.

3. I also recommend that a special inducement be presented to those who complete this advanced junior course to return and complete the course of the senior year by an increased appropriation of *one dollar a week* to the members of the senior class. This, in connection with the fifty dollars received upon grad-

uating, would reduce their expenses for the last year to about $100, and would, in my opinion, result in a larger number graduating than at present, on account of the higher professional value of a normal school diploma. The great advantage of this higher professional training to the State must be acknowledged by all.

IMPROVEMENTS AT EDINBORO.

Our recitation buildings have been entirely remodeled and rebuilt, and we have erected one new building for class-room work. The repairs and improvements are made in a plain and substantial manner, and we now have neat, convenient, commodious, and ample assembly and recitation rooms.

The following is a summary of our assembly and class-room accommodations:

1. A hall 56 by 80 by 22, for assembly purposes.
2. A hall 24 by 50, for small assemblies and chorus class exercises.
3. Two halls 24 by 38, for literary societies.
4. Three class rooms 30 by 30 and five class-rooms 20 by 30, for recitation purposes.
5. A library room 42 by 65.
6. Three model school study rooms 28 by 40.
7. Eight model-school recitation-rooms 13 by 21.
8. Three apparatus rooms 13 by 26.

Special attention has been paid to light and ventilation, and we are putting in a combination heating apparatus, to warm the building by hot water and warm air.

The library room is, on the whole, the one in which we take the most pride, and on whose contents we expect to expend the most money. During the past year we have increased the library by six hundred and fifty volumes.

MANSFIELD'S GOOD INTENTIONS.

In the beginning of the year we endeavored to make our work more distinctly that of a professional training school for teachers, and to this end more stress was laid upon the professional studies, and especially upon the practical work of teaching. The members of the senior class were required to do additional work in this department, teaching under the immediate supervision and criticism of the principal and other members of the faculty.

KUTZTOWN ON FINAL EXAMINATIONS.

The policy of requiring candidates for graduation to teach before the board of examiners, deserves careful discussion. Without doubt, it makes them more careful in their model school work, and this fact perhaps outweighs all arguments against the plan. For when, in order to acquire professional skill, experiments are made upon living beings destined for immortality, those who conduct the experiments should do so with the most pains-taking care, and anything which spurs them to more diligent effort, is justifiable. But on the other hand we are in danger of expecting too much from such exhibition of teaching power and skill. In the very nature of the case the results cannot be satisfactory. The time allotted to each candidate (generally from five to ten minutes) is too short, and the nervous system too much exhausted by the previous strain of a long continued written examination to enable him to do himself justice, nor are he and the class altogether free from that embarrassment which, in the presence of strangers, distracts the attention and renders full mental concentration impossible.

It is a remarkable fact that, of those who graduate at our State normal schools, very few fail in teaching. This speaks well for those who have charge of the final examinations, and is an argument in favor of the present method of conducting the same. And yet, a feeling exists in certain localities that the examinations are not rigid enough, and that the holders of diplomas ought to submit to a reëxamination as often as they apply for a new situation. Now, it should be borne in mind that examinations are not a panacea for all the ills incident to a system of public instruction; that in no profession but teaching is the ordeal of examination a life-long possibility, and that the normal school graduate never fails to get a certificate if he is willing to subject himself to the indignity of a reëxamination. Indeed, there is not another class of schools in the land that tax the powers of the pupil in the same degree in order to test his fitness for graduation. At each of the two examinations, which I attended during the past year, there was one instance of loss of distinct vision resulting from the nervous exhaustion of the applicant. This might be avoided by examining the junior class on half the studies of the course, as suggested in the circular recently issued by your Department. But before the plan is finally adopted, I would suggest a thorough discussion of the *pros* and *cons* for following reasons:

1. Certain studies (like arithmetic) cannot be completed until the pupil has mastered other more advanced studies (like algebra and geometry). A knowledge of Latin greatly facilitates the study of higher English grammar. Hence, some branches of the senior year should be studied before the learner is prepared to pass his junior examination.

2. The tendency at normal schools is to crowd the greatest amount of work into the least possible time. If the clamor for more stringent tests prevail, we may, in a few years, have two examinations of equal severity with the present one, as the condition of securing the normal school diploma.

3. Graduates of higher institutions, not being able to graduate in less time than a year, will not be likely to seek the benefit of professional instruction at a normal school. The plan may thus widen the chasm between our colleges and normal schools.

ASPIRATIONS OF BLOOMSBURG.

We hope for a nearer approach to our ideal, in the preparation of teachers, when less of the senior year need be devoted to the academic studies, and more can be put upon the science and art of teaching.

WEST CHESTER'S NEW PROJECT.

The present plan of examination by the State Board should, I think, receive considerable modification to adapt it to the needs of the different schools. The method of examining the graduating classes in all the studies of the course, at the close of the year, is very wearing on students, and productive of bad results in several ways. I am well convinced that it would be much better to examine in a part of the course at the close of each year, thus encouraging concentration of effort, instead of an attempt to grasp so many studies at one time.

I submit the following as the best plan to meet the difficulty in this district, and, I think, with a slight modification, it will be found practicable in all normal schools of the State: Let the law be so modified that whenever students of normal schools, or practical teachers, have passed a satisfactory examination in any branch or branches, before the faculty of the school, that they shall be eligible to enter the exami-

nation in said branch or branches by the State Board *at its annual session, and if successful they shall receive* a certificate exempting them from further examination by said board in the branches thus completed, for the space of three years. If in the meantime they shall have completed all the branches of the *Elementary Course*, they shall be entitled to, and shall receive, the usual certificate of scholarship now granted to graduate in that course.

PROFESSIONAL WORK AT SHIPPENSBURG.

During the year special attention has been given to methods of instruction, and to practice teaching. Our student teachers are beginning to feel the necessity of more earnest attention to this part of their work, and to appreciate the benefits arising from careful and just criticism.

We intend that our model school shall be in fact what it is in name—a model school; one in which our student teachers may profitably observe as well as practice, and one in which the model pupils, having completed the course in that department, will be thoroughly prepared to enter upon the regular course in the normal department.

In conclusion, I cannot refrain from expressing my hearty approval of some efficient plan for admitting to the senior class, in all the normal schools of the State, only such candidates as shall have received the certificate of the regular board of examiners, granted for that purpose. I believe this would have a tendency to give greater thoroughness to the junior work, *and to elevate the standard of admission to the senior class.* It would also greatly relieve the intense nervous and mental strain which the candidate for graduation must unavoidably experience under the present system of examination.

CHANGES WANTED AT CALIFORNIA.

One marked change of practice with students is seen in the tendency to spend longer consecutive time in school than formerly. The practice of attending one term yearly for several years is out of fashion here, and a long pull and a strong pull at the course is very popular and common. We need now to change the course of studies, so as to have a third year, and a corresponding grade of graduation; and, also, we should change our mode of examinations, so that all candidates for the same degree, in all the schools, shall have the same test and pass on the same merits; and then will the general cause be largely benefited, and we, as a school, will have reason to rejoice in the general good.

INDIANA STEPS TO THE FRONT.

Changes have been made in the strictly professional work, that secure (*a*) to the junior students: 1st, Time for thorough study of school economy. 2d. One full term of instruction in methods of primary teaching. And 3d, Ample opportunity for observing the work done in the model school. (*b*) To the seniors: 1st, Only such an amount of work as they are capable of doing well within the year. 2d, Instruction throughout the year in didactics, including philosophy of teaching, methods of instruction, and school management. And 3d, Practice in the model school, with instruction and criticism, for at least one-half of the school year.

I feel confident that these changes will result in giving to the public schools of the State teachers well qualified, not only in subjects of study but also in the theory and practice of teaching.

WHAT LOCK HAVEN UNDERTAKES TO DO.

We do not pretend to offer any guarantee to make an expert of every teacher that takes a course with us. Law schools, theological seminaries, and medical colleges make no predictions as to the success or *failure of their respective graduates when entering* upon the practice of their chosen professions. Normal schools appreciate the truth, that "the intellect of man has limits which no extent of education can enable it to pass;" and all they can pretend to do, without inexcusable charlatanism, is to teach the professional work, the principles and practice of skilled teaching, in a skillful manner. We guarantee to do this, and no more. We undertake to acquaint our students of teaching with the best methods of teaching and discipline, and with all else that concerns the great work in which they are to engage; but it were the veriest quackery for any normal school to attempt to make expert teachers and disciplinarians of those who, by nature, are denied the tact and capacity. In the proper work of the normal school we shirk no responsibility.

## THE SOUL OF THE SCHOOL.

TEACHING is becoming more of a fixed profession among us. Many young people seek it as a permanent occupation. The idea that any one can be successful provided he has been over a certain course in school, is slowly dying out. Peculiar aptitudes and peculiar training are required, and high positions are given to those who have shown their capacity in lower.

When one has by patient care prepared himself fully for the duties of the station, and has shown himself qualified to conduct a school or a department, we believe it will be found conducive to the best interests of the work to give him large liberty of action. His special training ought to make him better prepared to decide questions of management, than friends who have had no such experience. Young teachers are wisely restrained by the immediate supervising care of committees; and all are encouraged by their interest, their advice, and their instruction in general matters But, having found a reliable man unto whom the work of the school is to be entrusted, it is poor policy to hamper him by restrictions in small details. His ways are the best for him, and to cause him to adapt them to the ideas of an outside body is frequently to interfere sadly with his success. It is too often like a "gentleman farmer" instructing his laborer how to swing a scythe, or his carpenter how to drive a nail.

This leads us directly to the necessity of strong personality and enthusiasm on behalf of the teacher. Every intelligent observer must have noticed how much, after all, de-

pends upon that individual. Fine houses, expensive surroundings, many books, much apparatus, may all be good, but they do not insure success. The soul of the school is the teacher. His must be the steady flame at which other torches can be lighted. If he is careless and indifferent, the scholars will be like him. If he is noisy in his work, they will insensibly become so. If he is energetic and pains taking, they will imitate his methods.

A good, live teacher will do much toward overcoming the difficulties which surround him. It is *mind*, after all, which is both the means and measure of success. There are true teachers in some of our schools, with limited appliances, producing excellent results; there are others whose every want is supplied, producing inferior results. Considered purely as an investment, there is nothing yields surer returns than a conscientious teacher with a talent for his special work.—*The Student.*

## GARFIELD, THE TEACHER.

REV. B A. HINSDALE.

AT Hiram Institute Mr. Garfield, now the President-elect of the United States, taught Latin, Greek, the higher mathematics, history, philosophy, English literature, English analysis, rhetoric, criticism, and occasionally one of the natural sciences. Though especially enthusiastic in particular lines of study and teaching, it was hard to see that Mr. Garfield did not teach Cæsar, Homer, geometry, English grammar, metaphysics and geology, equally well. On the whole he perhaps took least interest in the mathematical studies; but among the others it would be hard to name his favorites. In fact, of all the branches of knowledge taught in a college, there was no one that did not at some time engage his special attention and awaken his enthusiasm. It is not beneath the dignity of history to record that he always taught the class in English analysis, through which most of the better minds at some time passed; and that this study, often made dry and irksome, he clothed with light and filled with fire. Hundreds of eyes will kindle to day at mention of "Garfield's Analysis Class." His weekly rhetorical class, with its essays, declamations, debates and criticisms, was a great theatre of interest and improvement.

The method of conducting a recitation was his own, combining the question that required a text-book answer, the topic to be handled, the call for the pupil's own opinion, and the teacher's discussion of the matter in hand. As a drill-master, many teachers surpassed him; but as an educator in the best sense, he stood with the first. His class-room glowed with life. Probably no pupil remembers having spent in it a dull hour. While placing its proper valuation upon learning and information, his great aim was to awaken the faculties of the student. There is a process known to the laboratory as energizing a magnet. By passing electrical currents around a bar of common iron, the electrician gives the bar magnetic virtue. There is an analogous process known to the educator; the most important service that he can render the student is to energize him. Among the teachers whom I have known, Garfield stood alone as an energizer of young men and women. He revealed the world to the student, and the student to himself. He called out thought, set the faculties in full play, awakened courage, widened the field of mental vision, and poured in abundant measures of inspiration.

In those days boys of ability and character often found their way to Hiram Institute to take a few studies, but with no thought of pursuing an extended course of study. As their minds began to open, they began to reach out beyond the tether fixed by past education or present circumstances. Sometimes the fathers of these boys held them to the farm or the shop by the firm hand of parental counsel, or even of authority. Mr. Garfield was quick to find these boys out. He seemed to read them by intuition. He had had similar experiences. He knew a mind that was teeming with new facts, ideas and impressions, and could enter into its daily struggle. He saw that these boys were capable of wider action than the farm or the shop, and he sought to lead them out into the broader field. He counseled and encouraged them, and sought in all ways to steady them in the transition from the old to the new. He carried his expostulations to the heart of the parent. He has been known to say that he never found more pleasure than in "capturing boys." His conscious method was to arouse a keen interest in the world of thought and learning, to interest them in the school, to place before them high ideals; his unconscious method, to pour into them his own spirit, and to attach them to himself.

One of his most valuable offices was his morning lecture in the chapel to all the scholars. He ranged over the fields of Bible history, morals, education, teaching, science, literature, practical affairs, history, and life questions. These lectures may not have been

finished *ad unguem;* but they abounded in fresh facts, striking illustrations, and suggestive thoughts, and were warm with the breath of his own life. Particular pains were taken to place before the students ideals of life and character nobly wrought, and instinct with courage, manliness and truth. Though bounding with life and spirits himself, he was full of what Dr. Thomas Arnold called "moral thoughtfulness," and he strove to make his pupils temperate, morally serious, and reverent to truth.

He was eminently successful as a school administrator. He was firm, but kind; exacting, but sympathetic. He was fully alive to the sentiment of justice, and respected, even in the most unworthy, human nature and human rights. Then, as since, he was full of appreciation and generosity.

Naturally Garfield, the teacher, drew his pupils to himself with extraordinary power. Never have I seen such devotion to another teacher. An old Hiram student, now holding a responsible office in the public schools of Cleveland, speaking of the old times before Garfield went to college, says in a private letter: "Then began to grow up in me an admiration and love of Garfield that has never abated, and the like of which I have never known. A bow of recognition or a look from him was to me an inspiration."

## OUR COMMON SCHOOLS.

CHARLES F. ADAMS, JR.

HUGE mechanical educational machines, they are peculiar to our own time and country, and are organized, as nearly as possible, as a combination of the cotton mill and the railroad with the model state prison. The school committee is the board of direction, while the superintendent—the chief executive officer—sits in his central office with the time-table, which he calls a programme, before him, by which one hour twice a week is allotted to this study, and half an hour three times a week to that, and twenty hours a term to a third; and at such a time one class will be at this point and the other class at that, the whole moving with military precision to a given destination at a specified date. Mechanical methods could not be carried further. The organization is perfect. The machine works almost with the precision of clockwork. It is, however, company front all the time. From one point of view children are regarded as automatons; from another, as India-rubber bags; from a third, as so much raw material. They must receive the same mental nutriment in equal quantities and at fixed times. Its assimilation is wholly immaterial, but the motions must be gone through with. Finally, as raw material, they are emptied in at the primaries and marched out at the grammar grades—and it is well!

This was the very general—in fact, the inevitable— result on the large scale of the system of superintendency in vogue during the last twenty-five years. It was also, perhaps, a natural and necessary phase of development; something which had to be passed through, though it immediately resulted in several undesirable things. In the first place, so far as the child was concerned, the imitative or memorizing faculties only were cultivated, and little or no attention was paid to the thinking or reflective powers. Indeed, it may almost be said that a child of any originality, or with individual characteristics, was looked upon as wholly out of place in a public school. The idea, under the system, was masses of children designated from usage by names, instead of more conveniently by numbers, who learned certain rules by heart, and applied them with mechanical promptitude and correctness Any deviation from this semi military method was sternly repressed as a breach of correct discipline. Starting from this point, the course of so-called educational development up to a recent period has been natural, logical, and commonplace. There must have been just three steps to it—memorizing, examinations, programmes—the last two, the latest educational hobbies built upon the traditional foundation of the first.

The way in which these led from one on to the next is obvious enough. In the first place, time out of mind, all knowledge was, educationally speaking, looked upon as a vast accumulation of facts, rules, and definitions, and the grand aim and object of teaching was to impart as many as possible of these to the youthful mind. The way to impart was to cause them to be laboriously committed to memory. Thus the teacher sat in his chair, a sort of lone fisherman on the shore of the great ocean of things known; and he hooked up out of it now a rule, and now a fact, and then again a definition, and he gave them to the children, and saw that they swallowed them, whether they liked them or not, and whether they were nourished by them or not. But in process of time it became apparent to the more observing that the knowledge thus imparted was not retained; and the examination was then devised, as a means of assuring

the purveyor of knowledge that the facts, rules, and definitions imparted were held, so to speak, on the intellectual stomach, for at least a reasonable period. The examination, however, as it was organized and gradually ramified into a fully-developed whole, almost necessarily called the programme into existence. The world of knowledge was too large; there were too many facts and rules and definitions for the teacher, as well as for the taught; and so, for the protection of the former, it became necessary to stake out from the wide domain, by certain metes and bounds, the districts within which he was to search for the hidden treasures. Anything obtained or to be obtained outside was not to count The programme was thus a relief to the teacher, clearly marking, as it did, the limits within which the cramming process was to be carried on. It made his work possible. The development of the system was then complete.

Under these circumstances education being reduced to little more than a mechanical process of cramming, with periodical nerve-trials to ascertain the degree of retention, the average child not unnaturally felt toward his school, and what was there required of him, very much as a learned dog or monkey may be supposed to feel toward his task-master. Accordingly, the sickening dislike of school, and of things taught at school, is with the majority of those emancipated from it almost the strongest association connected with early life.

The work of organization being completed, and the mechanical having been overdone, a new course of thought was inevitable. A reaction was certain to come. It began several years ago. Of late it has assumed a more definite shape, and is finding clearer expression. This reaction is founded on very deep principles. Its direction is away from mechanism, and toward science. Indeed, the cardinal principle of this "new departure," if it may be so designated, is that there is just as much a science in developing the more ordinary faculties of the human mind as there is in raising crops or extracting minerals from the earth. There is an easy, natural, and attractive way of training the intellect, as there is of training the body, if your philosophy could but find it out. It is not the way to find it out, however, to analyze the thing to be taught, dividing and defining, and taking to pieces and putting together. On the contrary, the work must begin at the other end. The operation of the child's mind, the natural processes of growth and assimilation which go on in it, its inherent methods of development and acquisition, must be long and patiently studied. The superintendent of the future is thus a Baconian in his philosophy. He rejects at once all mechanism, all tradition, all *a priori* theories, all military methods. He has recourse to a slow, patient process of induction. Believing that the human mind is something more than a cabbage, he argues that if there is a science in manuring and growing cabbages, there is probably a science of mental development.

Accordingly, he watches the child in its mother's arms and at play. He sees it learn to speak and to walk, and analyzes the processes through which it does it. Then he follows the school-boy out to the ball-ground and the skating pond. Wherever he goes, he notices one thing; that at every age, from infancy to manhood, the child is continually learning to do with infinite ease and skill things most difficult to do—things which he himself would in vain attempt. If he questions that fact, he has but carefully to study the principles of equilibrium and momentum; and then, having thoroughly mastered them, and got them at his tongue's end, let him go upon the ice and try to follow some boy through a little fancy skating. He has taught the boy the rules of grammar, and then called upon him to write the English language; why is it, that he, having taught himself each principle of speed and balance involved, cannot now slide off on the outer edge? To skate is as difficult as to write; it is probably more difficult Yet in spite of hard teaching in the one case, and no teaching in the other, the boy can skate beautifully, and he can not write his native tongue at all. So the superintendent of the future learns a lesson on the skating-pond, and goes home from it with a new conception of the little worth of formulas, and more faith in practice. Thus it is in everything. The processes he applies to the child he finds that he cannot get any results from when he applies them to himself. Take base-ball, for instance. He teaches the child to write by putting it in a certain position, with a pen in its hand, and causing it to imitate with up-and down strokes a printed legend at the head of the page of a copy-book. This is done three half-hours a week. Then he himself studies the rules of base-ball, and takes a bat in his hand, and imitates blows, and runs imaginary bounds, and keeps it up painfully and conscientiously—as a good boy writes—three half-hours a week, for the entire term. And at the end of the term he can no more play base-ball than the boy can

write. Then he turns to the examination papers of the Norfolk county schools in Mr. Walton's report, and no longer asks himself, Why is this so? It is all clear to him now. He has been expecting of little children what he could not do himself. So he goes back to the beginning, and before he undertakes to teach, sits humbly down, a grown man, at Nature's knee, and patiently cons the alphabet of her methods.

The scientific superintendency is, however, as yet in its first infancy. It is wholly unorganized. How completely it is in its infancy, how wholly it lacks organization, becomes very apparent when the single indisputable fact is stated that in this country the development of the average human mind is not recognized by our highest institutions of learning as a scientific study at all. They pay no attention to it—make no provision for it. They have medical schools devoted to the study of man's body; they have dental schools devoted to the study of his teeth; but any one who is not a fool, the learned doctors tell us, can train the child's mind! All there is to know on that subject can be told in half an hour, and learned by practice at an older teacher's side in a few weeks. Is not this curious? That it is a fact is indisputable. There is a science of law, and schools and professors to teach it. There is a science of agriculture, and colleges devoted to its study. There is a science of mining, and institutes of technology in which it is taught. It is even claimed that there is a science of divinity. But when it comes to the educational development of those who are to constitute the future state, though we spend millions on millions upon it, the universities turn their heads away, and class them as something less than the grass of the field. They grade the child's mind as lower than its teeth. They assume that any callow youth, fresh from his graduate course, and with the ink hardly dry on his degree, is quite competent to train the first, though not to take care of the last. We thus turn over our children to those whom we would never dream of intrusting with our potato patch.

*Harper's Magazine.*

# EDITORIAL DEPARTMENT.

THE SCHOOL JOURNAL.

LANCASTER, DECEMBER, 1880.

J. P. WICKERSHAM. . . . . J. P. M'CASKEY

THE California teachers have requested the State Superintendent to take steps to have a chair of pedagogics established at the State University.

THE Indiana teachers propose to organize a mutual benefit association, as there is "no preparation by the State or otherwise for the support of superannuated teachers, or those who have been broken down by earnest and faithful work in the school-room."

M. JULES FERRY, Minister of Public Instruction, has addressed a circular to the rectors of the academies and the prefects of the departments, informing them that the annual education conferences are henceforth obligatory for all the primary school teachers in France. Traveling and other expenses are to be defrayed by the departments.

AT the meeting last week of the Michigan Teachers' Association, one of the school superintendents declared that of late there has been a falling off in the number of boys graduating from the high schools of the State, the average being about five girls to one boy, showing that the women are becoming better educated than the men.

THE International Congress of Education, held at Brussels in August, seemed to be unanimous in favor of free schools and compulsory education; and although corporal punishment is practiced in some of the schools represented, no one undertook to defend it in the congress.

IN a speech delivered in Congress in 1866, General Garfield mentions the millions of dollars raised annually in Ohio for the support of common schools, the thousands of schoolhouses there erected, and the hundreds of thousands of children educated at the public expense; and says in connection, "This, in my judgment, is the proper gauge by which to measure the progress and glory of a State."

THE Minister of Public Instruction in France has issued a circular, dated Sept. 2, 1880, by which all the lyceums and commercial colleges are directed to introduce, at the beginning of the next school year, the course of study prepared by the new Council

of Public Instruction. In the new course more time is allowed for modern languages and natural sciences, while the number of Greek and Latin lessons is somewhat reduced.

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WE cannot fail, in the absence of any special department of book notices in the present issue, to call attention to the admirable and beautiful series of reading books prepared by Messrs. William Swinton and George R. Cathcart, and published by Messrs. Ivison, Blakeman, Taylor & Company, of New York, entitled Swinton's Supplementary Readers. In illustrations, as in reading matter and every other feature of the books, they are of the highest excellence They comprise six books, one "supplementary" to each of the first four grades of the ordinary series, and the last two, "Seven American Classics" and "Seven British Classics," corresponding to the ordinary Fifth Reader.

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A FRENCH educational journal commends a gentleman in the province of Pas de-Calais who has given a lot of land containing 4 ares' and 34 centiares, to be used as a teachers' garden. Teachers' gardens are a rare thing in connection with the school houses in this country.

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A FIRM in the Rue de Rennes, Paris, advertise a neat case, designed for a collection of things to be used in object lessons. It contains twelve shelves, each divided into nine apartments. The first shelf is intended for a collection of *woods;* the second, for *minerals;* the third and fourth, for *metals;* the fifth and sixth, for *textiles;* the seventh and eighth, for *alimentary substances;* the ninth for *combustibles;* the tenth and eleventh, for *the products of the neighborhood*, and the twelfth, for *hurtful insects*. The whole is a little museum which can be made exceedingly valuable in a school. Will not some of our school-furniture men get up one of a similar character for our schools?

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THE establishment of a central "trade school" (handwerkerschule) was decided upon by the Berlin city authorities during the present year. The school will be opened Oct 10, at No. 52 Kurstrasse. Every person over school age who possesses at least a fair knowledge of the branches taught in elementary schools, may be admitted. The institution is, therefore, equally of importance to persons who do not learn trades. The school is p aced in charge of Director O. Jessen, formerly Director of the Industrial School of Hamburg, where he has earned the reputation of a distinguished educator. The course of instruction includes free-hand drawing, geometry, technical drawing for mechanics, modeling, mechanics, chemistry, commercial arithmetic, physics, and book-keeping. Instruction is given on Sunday from 8 to 12 a. m., and on week days, from 7 to 9 p. m. Each pupil may choose his branches; he has only to prove that he possesses the ability of deriving benefits from the lessons he selects. Certificates are issued at the end of each semester of twenty weeks. The tuition fees range between 6 and 12 marks (1 mark, 25 cents), according to the number of hours a pupil attends. The school authorities may admit poor pupils gratuitously.

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THE fourth number of Butler's Literary Selections, "Ten-times Ten" series, has just reached us, as we are about to go to press. It is devoted to character sketches, humor, sentiment. and pathos, and is just the kind of book for good-natured teachers to have within reach for more or less frequent readings to their pupils. The number of selections is one hundred, and the price of the book thirty-five cents. It may be had, by mail, from Messrs. J. H. Butler & Company, Philadelphia. The value of the book is far beyond its cost. We know nothing of its kind to equal it.

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AN Austrian schoolmistress feels unkindly toward Miss Gladstone, the daughter of the English Premier, and expresses her feelings in a letter to the Vienna *New Free Press*. Miss Gladstone teaches a school at Hawarden, because she thinks it a good thing for a lady to be useful, and the public praise bestowed upon her for putting her views into practice has reached the Austrian schoolmistress. The letter upbraids the English lady for taking work and bread from some poor young woman, who is deprived of a situation because a "lady"—whose chief duty, as the schoolmistress thinks, is to be ornamental—chooses to play at keeping school. This Austrian censor would probably hold to the same view, even if she knew that Miss Gladstone created and carried on at her own expense the school that is so fortunate as to have her services as a teacher.

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"GEN. ARMSTRONG is compelled to weed out twenty per cent. of his entering classes of colored pupils, in the Hampton Normal School, for radical defects of character. May not this vigorous work among the moral foundations account for the eminent success

of this famous school in training teachers for the colored people? And might it not be a good move for the principals of our normal and training schools for white teachers, to keep a sharper eye on the *quality of manhood and womanhood* in the young people whom they send forth as experts to guide the children? Many a young man or woman who is capable of a good deal of 'culture,' and can be drilled into a marvelous dexterity in superficial 'methods,' is 'built upon the sand,' and is sure to go the way of all feeble and incompetent workers among men, at the first freshet or hurricane in the school-room."

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A PROGRESSIVE editor in one of our country towns says: "The schools have been in session three weeks, and we ask how many parents have visited the schools to show their interest in them, or to find out if they were doing as well as they ought, or for any legitimate purpose? Parents ought to do this, and it will not be long until it will have an effect for good upon the pupils. A teacher cannot hide defective government or teaching in your presence; it will show itself. Have the directors visited the school and commended when deserved? The children are inspirited by proper visitation and teachers encouraged. How many of our readers visit or go with their children to school?"

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A LARGE number of school districts in Chester county have for a long time been in the way of furnishing free text-books to the pupils in the public schools. In his last report, County Superintendent Harvey thus speaks in commendation of the plan: "More of our boards furnish text-books at the expense of the district every year. Teachers generally see that pupils take proper care of these, and the measure is growing in popularity; in fact, it seems to be impossible to have the schools properly classified unless the books are so furnished. An experience of more than twenty five years in teaching, and more than three years in visiting schools, has firmly convinced me that furnishing text-books at the expense of the district is not only a saving of expense, but a great factor in the teaching force."

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MISS EDITH SIMCOX, a member of the London School Board, read a paper on Practical Education at the recent meeting of the American Social Science Association. We extract the following paragraph:

No part of a child's school knowledge can be safely allowed to remain long detached from its daily life. The history and geography of lesson books must join on to that of the newspapers; it is almost worse to know the name and date of a writer or a hero without an independent familiarity with the nature of his books or actions than to be frankly ignorant of all at once; and in every branch of science it is admitted that a knowledge of definitions and formulæ is useless apart from experimental acquaintance with the actual bodies described. An inaccurate general knowledge, that would not stand the test of examination, may even in some cases have more educational value than a few correct and barren facts; and our educational results will not be thoroughly satisfactory if detailed information is imparted faster than circumstantial impressions about its color and bearing. Schoolmasters are already complaining loudly of the system of cramming necessitated by the tyranny of examinations. Schoolmistresses still look to examinations as their hope of deliverance from inaccurate and slipshod methods of learning and teaching. But it must be remembered that, although no ignorant teacher can pass a searching examination, not every teacher who can pass such an examination is necessarily well educated. All so-called higher education is worthless that does not include a great deal more than can be tested by a short examination; and in these busy days perhaps the greatest service that educated women have in their power to render to the community is to keep alive the menaced tradition of wide and disinterested general culture.

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THE *Neue Freie Fresse* extracts from a Russian journal called the *Elementary School Teacher* some interesting statistics of elementary education in Russia. It appears that of all children in St. Petersburg who are of fit age for school, only 41 per cent. are actually being taught. There are 30,000 children in St. Petersburg who go to no school whatever. The government of St. Petersburg—that is, the district of which St. Petersburg is the centre—is still worse off. Not quite 25 per cent. of the children go to school. In the Moscow government the percentage is only 15, while in the town of Moscow itself it goes as low as 12. In the Tambow government the figures are 7½ per cent., in that of Poltowa 7 per cent., and the same in that of Samana. In only a few governments is the percentage apparently higher. In Bessarabia 40 per cent. of the children go to school, in Kazan 30 per cent., in Penza 28 per cent. There are districts here and there in different governments—those of Kalugo or Saratow, for instance—where the number of children who can read and write is a good deal higher than the average of the province. The worst of it is that in all these cases the population is not pure Russian, but contains a strong German or Finnish element. The position occupied by Bessarabia points in the same direction. The Russian journal concludes its remarks by pointing out that if all the Rus-

sian people are to be educated there will be 1,000 new schools wanted in the St. Petersburg government, 2,600 in that of Novgorod, and, not to mention other instances, as many as 5,000 in that of Charkow.

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ALMOST a hundred years ago (August, 1786), Thomas Jefferson, representative of the new Confederacy of the United States in Paris, wrote to George Wythe, of Virginia: "If any body thinks that kings, nobles, or priests, are good conservators of the public happiness, send him here. He will see here, with his own eyes, that these descriptions of men are an abandoned conspiracy against the happiness of the people. Preach, my dear sir, a crusade against ignorance; establish and improve the law for educating the common people. Let our countrymen know, that our people alone can protect us against these evils; and that the tax which will be paid for this purpose is not more than the thousandth part of what will be paid to kings, priests, and nobles, who will rise up among us if we leave the people in ignorance."

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THE February number of the *Vyestnik Evropy* contains some remarks on the educational statistics of Russia. From these it appears that fifty per cent. of the pupils attend the middle-class schools and receive a classical education. Of these, however, only seven or eight per cent. pass on to the high schools, the others breaking off at the less advanced stage. Thirty per cent. study with a special view to the clerical office, but very few of these attain to positions in the Church. The pupils attending the private middle-class schools are reckoned at six per cent., and the remaining fourteen per cent. may be divided between the real schools and the military gymnasia.

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FOUNDER'S day, at Lehigh University, October 15, was celebrated with much enthusiasm by a great throng of people. An eye-witness writes: "Seats for 1,000 persons had been arranged in this commodious structure, and the hall at the hour named was simply packed. Long before the hour the guests began thronging into the grounds, which wore an unusually fine appearance. The day was delightfully pleasant, the autumn foliage in all its brilliancy surrounded the elegant university with a gorgeous drapery, the building itself being decked with flags and bunting in large quantity. The University building is a very picturesque structure, and the entire scene was one well worth viewing. The park surrounding the University building and the halls have lately been rearranged and presented a most inviting appearance At 11 o'clock Mark Hassler's Orchestra of Philadelphia struck up a fine march, and to its music the procession of distinguished guests, alumni and students, lead by Rt. Rev. M A. De Wolfe Howe, D. D., LL. D., and President Lamberton, entered the building. Senator Bayard, of Delaware, delivered an able and eloquent address. This was followed by a series of games by the students, and in the evening there was a beutiful display of fireworks."

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MR. DAWES, of Massachusetts, in a recent speech in the Senate, uttered these strong words on the policy of educating the Indians:

"I thank God that the policy of extermination, so long pursued by the government and the army, is to be abandoned as a notorious failure. I had no confidence in the scheme to settle the Indians on lands conveyed to them in severalty, or in any attempt to govern them through courts of justice administered after American models, so long as they remain in their present condition of ignorance and aboriginal clannishness. I believe, with Senator Teller, of Colorado, that the adult Indian cannot be tutored or driven to maintain himself by farming, and that no influences that can be brought to bear from any direction will overcome the sentiment of clanship inbred by the tribal relation maintained among them from time immemorial. In my judgment, there is but one course that promises any positive and lasting success, and this is to educate the children; taking them at an early age and initiating them into civilization, by teaching them our own language, manners, and customs, and inculcating habits of industry. Education furnishes the only means of redeeming a savage race, and relieving the government from the constantly increasing burdens of a policy proved to be destructive to the Indians and demoralizing to our own people."

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AT the meeting of the school directors of Chester county, held at the court house during Institnte week, we were pleased to see among them several ladies, members of Boards, who seemed to be most deeply interested in the proceedings. Chester is about the only county that has given much effect to the provision in our new Constitution, which allows women to hold any office connected with public education. Tioga and Lackawanna have ladies holding the office of county superintendent; but outside of Chester and Delaware very few ladies have been elected school directors. We think this is a mistake. The ladies that now hold the office are among the most efficient directors in the State, and we think it would be wise to increase their number. England seems to be ahead of us in this particular. In *Modern Thought*, London, we find the following:

London is not the only city which has gladly welcomed women candidates. Manchester elected Miss Becker three times. Brighton returned Miss Ricketts at the head of the poll; Bath in 1870 elected two ladies; Birmingham, Huddersfield, Oxford, Exeter, all followed this example. In Scotland a very large number of ladies were elected, and in subsequent elections many other towns and small country districts have raised women to this position of trust. Nor has this confidence been misplaced. They have shown themselves fully the equals of men in their business capacity, and their superiors in philanthropic schemes. Mrs. Buctan, in Leeds, organized a system of hygienic instruction by which poor women and girls have been greatly benefited, and has introduced, among other reforms, flower-culture exhibitions among the children. It was owing to Miss Chessar's efforts that swimming, a most useful physical exercise, was introduced into girls' schools. Other ladies have given their attention to the development of the Kindergarten system, others to the improvement of elementary needlework, others to practical instruction in cooking. The future artisans' homes of England will be brighter, neater, and healthier, for the indefatigable efforts of this devoted band of laborers.

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REV A. D. MAYO, in an article in the New England *Journal of Education*, on "The Secret of Frederick Froebel," concludes in this admirable way:

The real claim of Frederick Froebel on immortality is in the early perception and faithful inculcation, for fifty years, of a few very simple ideas about educating the child:

*First:* That every child of man is a child of Almighty God, and is all the time being educated by God in a glorious university, the universe in which he lives, through all the agencies and events which go to make up our human life.

*Second:* That all education that really tells on a child must be in the same line with this life-education by God's providence; what we sometimes call the method of Nature. That we succeed with children only when we try to wake up and expand the faculties they actually possess, and direct them to the world in which they live for objects to satisfy these faculties; to Nature for information of the ways of God in the physical universe; to work of some sort to develop the creative, executive character and powers; to the real life of man as seen in the going on of affairs, and the history of the past for instruction in the higher laws of the soul. To try to educate a child by putting knowledge into his memory from the outside, without the waking, training, and unfolding the child himself, is like trying to raise peaches by tying peach-blossoms, in spring, on the palings of a garden-fence.

*Third:* That parents and children belong together, and the law of all good training is: "*The parents should live with the children;*" not only in the same house, but in the same spiritual world, living in all their hopes, and joys, and sorrows, and giving their best life to moulding the mental and spiritual character of the little ones. And as women can enter into the feelings of good parents better than men, they are, properly trained and educated, the fit teachers of little children.

*Fourth:* That the aim in all real education is not to make of a child a machine to do a special sort of work, but to develop a child into a true woman or man, in the broadest sense of the word.

In these broad and catholic ideas, which go to the foundation of all training of the young, is found the secret of Frederick Froebel. And these are the ideas that must prevail, as man in all climes and all new ages comes to a knowledge of himself.

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THE *Mountain Beacon*, speaking for the working men in the coal region, thus deprecatingly points out the difficulty in the way of bringing higher education within the reach of the masses:

Who are they who to-day can reach that "Higher Education" upon which educational monthlies and normal school professors are continually harping? Who, indeed, especially in the anthracite coal fields of Pennsylvania, can hope for even a fair common school education? Assuredly not the children of the sons of toil. With low wages and only three days' work a week, the muscle and sinew of every boy and girl ten years old must be called into action in order to provide the commonest necessaries of life. They must go to the breakers, be sent down into the mines, gather and sell berries, live out as servants, ply the needle, bend over the wash tub in tender years, and even then are the poor thankful for the coarsest fare from day to day. "Higher Education" indeed! For whom is this "Higher Education" provided? If the State by law makes education free "for every child in the Commonwealth," combined capital counteracts law, and dashes the cup untasted from the lips of the poor.

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THE delightful subject of Star Study has attracted an extraordinary degree of attention among the teachers of Lancaster county during the past year. Probably not less than two hundred teachers have been tracing the constellations in the heavens, noting individual stars by their names, and making extended lists, with diagrams of direction and distance, for use in their schools. They report that no subject they have ever presented to their pupils has aroused more hearty interest, or been attended with more satisfactory results. It is also spreading out from the schools into the community. This year the work of the Lancaster Star Club, during the past winter, in its papers and Star List, was included in the special music supplement for the Institute session, thus placing in the hands of every teacher a text-book of great practical value, which Prof. S. B. Heiges assured the Institute was "the best he had ever seen," except Proctor's "Half-Hours with the Stars." We present in this issue of *The Journal* the first part of these papers, knowing that they will attract much attention in various parts of the State; the remainder of them, with the Star List, will appear in our issue for January or February. The following is the introduction to these papers in the

special music pamphlet to which reference has been made:

But, while the Supplement contains its Twenty Songs and Hymns, the music in parts, and gives the words of twelve or fifteen additional selections without the music, it is in its Star Club Papers, and in its Stars and Star Groups and other related matter, that it possesses especial value. The work of the Star Club has been presented here in form as full and complete as possible. The Star List of last year, also, and one or two additional pages, are reprinted with little modification, from former Supplement, for accent, dates, directions, distances, relative positions, mythological fancies, and reference generally. The several Star Club papers treat, for the most part, of the Solar System—as a unit, in its several members, and in its varied and wonderful phenomena. They discuss its amazing features of vastness incomprehensible, velocities incredible, distances immeasurable, unreckoned lapse of time, and overwhelming grandeur. Then the scene changes, and as we contemplate the Zodiac and the far-speeding Light, all the immensity with which we have been in contact is dwarfed to nothingness. It becomes a mere point in space, around which in every direction lies the illimitable Universe, with its myriads of blazing suns. Then the constellated Stars—the same splendid orbs beneath which Abraham worshiped and David sang; the same that shone above the builder of the Pyramid; the same the Magi knew. This pamphlet thus becomes an excellent working text-book for the individual student, the school-room, or the Star Club comprising old and young in its membership. Read one of these papers at stated intervals before such organization: discuss it; elaborate points presented; present additional points for investigation; follow the work of the Star List; and many pleasant and profitable evenings are assured. The personal gratitude which a deep-souled pupil may feel towards the teacher who has introduced him to a study of such life-long interest is elsewhere well expressed by Bishop Warren. It is enduring.

## SEWING IN THE BOSTON SCHOOLS.

IT is known, we presume, in a general way, by most of our readers, that sewing has been taught for several years in the public schools of Boston. The school of widest repute for this specialty is the Winthrop School, of which Robert Swan, a teacher of very large experience, has been principal for many years. Desiring to learn directly the results attained by the introduction of this new branch into the schools, and the plan of giving instruction in it, we some time since sent a letter of inquiry to Mr. Swan, to which we received both a formal reply and a personal letter, imparting more detailed information. We herewith print them, and take pleasure in calling attention to their contents. Especially do we ask the school boards in our cities and towns to consider the propriety of following the example of Boston in this matter, believing with Mr. Swan that "in no other way can girls be more benefited than to receive instructions in sewing with the rudimentary school studies." The introduction of sewing requires no change in our laws. The matter is entirely in the discretion of school boards.

FORMAL STATEMENT.

BOSTON, MAY, 1880.

Instruction in sewing, for the last ten years, has been given throughout the Winthrop school, by a teacher employed for that purpose, who devotes the same time as the other teachers and receives similar compensation.

The divisions of the sixth, fifth and fourth classes have two lessons of an hour each per week; the third and second, one lesson of an hour under the regular teacher. The girls of the first class are taught to cut and fit by measurement and drafting.

The material is brought from the homes; the work is prepared by the teacher, and is kept at the school in a large work-basket one being supplied for each class). When completed it is examined by the regular teacher, of the class, and if satisfactorily done, is given to the child to take home. If from any cause, a scholar is without the proper material, it is furnished from a supply procured from a charitable society; but, in such cases, the garment is not given to the maker, but is returned to the society. With this rule, there is no difficulty in procuring material without expense to the city, except some thread, needles and thimbles, for emergencies. Cases frequently occur where very poor children save their pennies and thus procure the needed work.

The class is disciplined by the regular teacher; she also distributes the work before the sewing teacher enters the room, that no time may be lost from the hour for instruction.

In mixed schools (girls and boys) the girls can be taken from two or more classes to form a division for sewing, and the boys of the classes can be usually employed at the same time, as one class, upon reviews or some other exercise which the teacher may elect. The teachers can alternate in the sewing class.

The following is the order of instruction: Back-stitching, hemming, top-sewing, overca ting, running, felling, gathering, stroking gathers, hemming on gathers, button holes, sewing on buttons, mending, darning, basting, flannel stitch, herring-bone stitch, feather-stitch: cutting.

As it is desirable that the instruction shall be such as to accomplish the most good, not only to the children but also in the homes whence they come, the pupils are encouraged

to bring garments and other large pieces that can be utilized in the family, thus relieving the mothers from many weary hours of night work, and at the same time, giving opportunity for the best quality of instruction.

ROBERT SWAN, *Master*,
ISABELLA CUMMING, *Teacher*.

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MR. SWAN'S LETTER.

WINTHROP SCHOOL,
BOSTON, Oct. 29, 1880.

*To the State Superintendent Public Schools, Penna.—Dear Sir:* I was glad to receive your letter in regard to sewing in schools, and immediately forwarded the directions which we observe in teaching it There is but little in addition to say. I wish to add only a few words of minor detail. Ours is a large school, containing from 800 to 1000 girls, and there is constant employment for the teacher.

Where there are not so many to receive the instruction, one teacher can be employed in several schools. In selecting a teacher, a person of remarkable tact and skill is needed. It is too often thought that some needy woman is sufficient for such a place. When this is the standard, failure awaits the experiment. We expect to meet with opposition from teachers. It was the case in Boston and I was among those opposed; but recently, when a communication was sent to the principals of schools for an opinion on the subject, there was a decided unanimity among them that there was scarcely any instruction more beneficial to girls. It is surprising to note the wonderful change it produces in the appearance of the children. We include some of the very poor districts of the city, but it is not unusual for visiting strangers to remark that we must receive our scholars from families in comparativety good circumstances, and the opinion is formed from the appearance of the school. Every child is able to take care of her own dress, and this same care is bestowed on the brothers and other members of the family at home. What a blessing to a community to have all the women educated needle women! The expense of the instruction is more than saved in decreased pauperism. Just as much as ever is accomplished in the other branches of study.

The teacher has a class-book in which every piece of finished work is recorded, and a yearly exhibition is given at the schoolhouse. I have taught school more than forty years, twenty-four in the present school; and I am fully convinced that in no other way can girls be more benefited than to receive the instruction in sewing with the rudimentary school studies.

Truly yours, ROBERT SWAN.

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We append the following Report of Sewing done by the scholars, from September, 1879, to July, 1880:

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| Aprons | 712 | Night Caps | 3 |
| Bags | 115 | Night Dresses | 21 |
| Bibs | 28 | Napkins | 99 |
| Boot Bags | 3 | Pillow Shams | 18 |
| Boys' Suits | 2 | Pillow Slips | 269 |
| Button Holes | 1090 | Sheets | 14 |
| Children's Dresses | 48 | Shirts | 12 |
| Collars | 12 | Skirts | 70 |
| Cuffs | 10 | Sleeves | 65 |
| Curtain | 1 | Stockings mended | 36 |
| Dresses | 5 | Table Cloths | 15 |
| Dressing Sacques | 7 | Towels | 159 |
| Dusting Caps | 2 | Traveling Bag | 1 |
| Garments mended | 8 | Undergarments | 370 |
| Handkerchiefs | 317 | | |
| Lap Bags | 175 | Total | 3688 |
| Necktie | 1 | | |

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## CODE OF HONOR IN SCHOOLS.

THE following brief essay, written by William W. Kent, drew the first prize at the Teachers' Institute recently held in West Chester. It is in answer to the question: "To what extent should innocent pupils be held responsible for disorder."

This question admits of two divisions: the one involving the case of an innocent boy informing on another, without having been questioned by the teacher, becoming what is commonly known as a tell-tale; the other involving the case of a boy's informing when he is personally questioned, or when the school as a body is questioned concerning the author of some mischief.

As I understand the requirements, we are to deal with the second division.

The facts are that if any mischief is perpetrated in school, the teacher is generally unable to detect with certainty the boy who committed the act. This fact is due to a certain code of honor existing among the scholars; an idea, that to inform on a comrade or a mate is mean, and deserving of all the sneers and scoffs that are afterwards heaped upon them if they violate this code of honor.

The prevailing habit in schools to shield the criminal encourages boys to commit some mischief, while if they were exposed they would feel ashamed of their conduct, thus leading good boys into evil ways, creating in school disorder and mischief.

This habit, if carried into the social world, leads to the countenancing of social evils. If carried into the political world, it leads to the silencing of those people who expose to our sight crime and corruption in politics. If carried into the field of morals at large, it leads directly to winking at crime.

If this code of honor were to actuate us in other matters as it does in school affairs, the robber would be encouraged in his work, the murderer would not be detected. In short, the prevalence of such a code

of honor would cause a monstrous increase of crime and the punishment of none.

Our criminal courts tolerate no such sentiment. The man who witnesses crime may be summoned to court and compelled by law to testify. The immorality of such a sentiment in our schools or in the community is obvious.

Hence it should be uprooted and supplanted by a better one. How may this be done? By writing essays on the subject, by agitating the subject in your neighborhood and arousing the people's thoughts on this question, and creating, if possible, out of school, a public sentiment in your favor, and, most important of all, by holding the whole school responsible for any mischief that is done. This responsibility will encourage the innocent to search out and bring to justice the guilty.

And then it is very important that the teacher, by short talks or otherwise, should uphold the informer and justify him in his course, and thus arm him against the abuse that will naturally follow from the detected criminal and his associates.

As well as teaching your pupils geography and history, teach them to venerate truth and hate falsehood, to commend innocence and expose crime.

The question may arise, "Is it practicable to hold the innocent responsible for the misconduct of others until the offender is detected and bronght to justice?" Dr. Hays, in answer to such a que tion, says that he practiced it in his school with great success. It strikes at the very root of college rows and hazing.

We have endeavored to prove that the present existing public sentiment in regard to this matter is productive of disorder and mischief in schools, and if carried further would produce moral corruption, and that for these reasons the public sentiment should be changed. If this be true, what is wanting is the co-operative influence, in the right direction, of parents, directors and teachers, and the reform will be accomplished; a new code of honor will be established, the guilty will be brought to justice, and the teacher will have comparatively no trouble in preserving order and good decorum.

This change for the better will influence the mind and habits of every pupil. Orderly schools inculcate orderly thoughts and habits, and create a growing sentiment in the minds of the pupils in favor of all that is orderly and good, preparing them to become good and law-abiding citizens in after-life.

## TAKE A JOURNAL OF EDUCATION.

THE following article is from the New England *Journal of Education*. We endorse every word of it. There is no one thing that surprises and mortifies us so much as the fact that so few of our teachers read an educational journal, or indeed make any effort to keep themselves informed of what is passing in the educational world. They obtain a position, and work away in it to the best of their knowledge; but they persistently shut their eyes to the new ideas that are constantly springing up concerning the doctrines and the processes of education, and allow themselves, unconsciously perhaps, to be drawn into a state of professional stagnation. We are ashamed to confess it, but there are counties in Pennsylvania in which scarcely a single teacher subscribes for an educational journal or ever takes up a book on teaching. With such teachers no earthly power can make good schools. Even superintendents forget this. Unless teachers read, study, think about their work, they cannot do it well. We must have live teachers, or our schools will be dead.

But read what our New England cotemporary has to say:

There are thousands of teachers in our country,—too many of them in the most cultivated centres of school-life,—who are destined to failure from the narrowness of their professional outlook. They read no book on the art of instruction; they neglect the study that keeps the mind alive; they have money enough for social entertainments and personal adornment, but not a cent for an educational journal. They are living in almost complete ignorance of the great stir in the school life of the land. Now and then, through the daily paper or an accidental collision with a rough critic, they learn that there is a great deal of fault found with the teachers, and a tremendous hubbub over the schools. But all this is treated like a thunderstorm, or any disagreeable state of the elements,—simply as a warning to get indoors, close the shutters, make yourself comfortable, and let things rage outside. Too many of our young women-teachers who have excellent stuff in them, and are capable of a vigorous push for self-culture and true professional success, are now suffering from this narrowness of outlook. They are putting on fine airs of personal dignity in the face of this storm of criticism, and treating all public exception to their work as a sort of personal affront to themselves. We know many a high-strung and really charming young schoolma'am who puts the public, by whose favor she stands in the school room and by whose money she lives, on the same footing as the forward young gentleman who pushes his attentions freely, or ventures on a remark not flattering to her personal pride. The spectacle of a spirited young lady in the teacher's desk affecting to snub the town or city whose public official she is, shirking the institute and the convention, too busy about her own private affairs to read professional books, or even to join a club that subscribes for an educational paper, is not inspiring.

*The thing that should be done by at least a hundred thousand American teachers, this month, is to subscribe for a good educational journal.* There they will learn what the superior part of the American people are saying about them and their schools. They will see there against what odds the friends of the best education are contending, and realize how many unfriendly tendencies are conspiring to block the wheels of popular intelligence and stay the coming of new light to the republic. There they will see their own weakness, even the most unpleasant qualities of their own personality, reflected in a mirror that is their best friend in revealing them as they are. They will find there the heartiest and the most thoughtful and delicate recognition of their merits—a hand stretched out as they are about to sink in the slough of despond—a word of good cheer for a dark day—a tender whisper of consolation for a hidden sorrow—a friend that will come to them every week, or month, and lift them out of the narrowness of the

present into an ideal realm of aspiration and cheerful hope. Many a teacher owes her awakening to a new professional life, and her final achievment of genuine success to the few dollars she was persuaded to invest in educational journals. No little mistress is too poor or obscure, no great master is too busy or famous, to afford to dispense with such a mirror of the educational world of to-day. Begin the school-year by investing in this mirror, and study yourself in it every morning and evening as the days go on.

## THE COMMON SCHOOL LAW.

### RECOLLECTIONS OF ONE WHO HELPED TO PASS IT.

AMONG the few men still living who were in the Legislature at the time of the passage of the School Law of 1834, and who took a prominent part in its enactment is Hon. Elijah F. Pennypacker, of Chester county. He was a member of the Legislature in 1831, '32, '34 and '35, Secretary of the Board of Canal Commissioners in 1836, '37, and in 1838 a member of the Board, so that he was at Harrisburg during the time the School Law was under discussion, when it passed, and while the earlier measures were adopted for putting it in operation. He was well acquainted with Governor Wolf, and the intimate friend of Governor Ritner, Thaddeus Stevens and Thomas H. Burrowes Although not on the Committee of Education in the House of Representatives, where he served during the memorable session of 1834, he was an ardent friend of popular education, and voted and gave his influence for the bill establishing our common school system Mr. Pennypacker, although seventy-six years old, still walks as erect as in his younger days, and is in excellent health. We recently met him at the Convention of School Directors in Chester county, and his speech has lost none of its old-time directness and force. We present below Mr. Pennypacker's recollections connected with the passage of the School Law of 1834, and we have no doubt they will be read with interest and pleasure.

#### RECOLLECTIONS.

In complying with thy request to give thee some views and reminscences in connection with the passage of the School Law, which with some amendments resulted in the present educational system by common schools, I shall go back and give what was expressed in the several constitutions previous to this time as a type of the prevailing sentiment.

William Penn in his frame of government had the following clause: "That all the children within this province of the age of twelve years shall be taught some useful trade or skill, to the end that none may be idle, but the poor may work to live, and the rich, if they become poor, may not want."

Penn's proprietary form of government was succeeded by the constitution framed by a convention which assembled in Philadelphia, July 15th, 1776. It contains the following clause: "A school or schools shall be established in each county by the Legislature, for the convenient instruction of youth, with such salaries to the masters paid by the public as may enable them to instruct youth at low prices. And all useful learning shall be duly encouraged and promoted in one or more universities."

The Constitution of 1776 was superseded by another, framed by a convention which met in Philadelphia on the 24th day of November, 1789, and contains the following clause: "The Legislature shall as soon as conveniently may be, provide by law for the establishment of schools throughout the state in such manner that the poor may be taught gratis." This constitution was amended by a convention which met at Harrisburg, A. D., 1838, but it left the foregoing clause in reference to education unaltered.

The constitution now in force, framed by a convention which met in the year 1873, contains the following clause: "The General Assembly shall provide for the maintenance and support of a thorough and efficient system of common schools, wherein all the children of this Commonwealth above the age of six years may be educated, and shall appropriate at least one million dollars each year for that purpose."

Excuse the tedium of these extracts. They seemed indispensable to show the growth of the system which, with the present law and constitution, is now so deeply rooted in popular favor, and rests upon a firm basis Education assimilates readily with the principles of freedom.

It may be proper now to refer to what transpired in connection with the passage of the School Law. Although there had been growth in public sentiment previous to the year 1832, subsequent to that period the improvement in sentiment in relation to a general system of education progressed much more rapidly. The elements for and against were active. There were those who saw that the duty of the Commonwealth to the children of the Commonwealth was not fulfilled, and that the place we occupied was below that of New York state and New England. Some ardent friends of education opposed the sys-

tem because they already had schools at which their children were educated. A considerable portion of the German element of the Commonwealth opposed the system, being opposed to change, and to education except in moderate measure; but it is gratifying to know that since the adoption of the system they have have become its advocates. And we had two Governors of German extraction, ardent friends of the system—George Wolf and Joseph Ritner.

The earnest and highly intelligent messages of Governor Wolf on the subject of education did much towards bringing the necessity of the passage of a School Law to the attention of the Legislature and people. Clarkson, a member from the city of Philadelphia, of the session of 1832–3, was chairman of the committee on education. He made a report, in which he characterized the then existing School Law the pauper system, because it contemplated that the poor should be taught gratis. A bill was also reported and considered in committee of the whole and referred to the next Legislature.

At the session of 1833–4, the subject of universal education as a means of spreading intelligence and diminishing crime was elaborately and forcibly brought to the attention of the Legislature by Governor Wolf, and at that session an effort to elevate the Commonwealth by the passage of an improved School Law was vigorously commenced. A joint committee of the Senate and of the House was appointed. Samuel Breck, a member from Philadelphia county, a highly cultured gentleman and friend of education, was chairman of the Senate Committee, and Dr. Wilmer Worthington, of Chester county, was chairman of the House Committee, also a cultured gentleman and able advocate of education. The Senate Committee was very ably represented in the person of the chairman, Charles B. Penrose, of Cumberland county, William Jackson, of Chester county, and Almon H. Read of Susquehanna county. The educational interest in the House Committee was most strongly represented by the chairman and Dr. Samuel Anderson, of Delaware county. A bill was reported, the preparation of which was mainly accomplished by Samuel Breck, and the bill became a law without serious opposition.

The passage of an improved School Law, to be submitted to the people for their adoption, having become an acknowledged fact, tended to awaken and bring into activity all the elements of opposition to the law in the Commonwealth; and as a consequence the session of 1834–5, was made the turning point, and very strongly petitioned to repeal the act passed at the previous session.

The Senate committee of 1834–5 was Fullerton, Read, Smith, Middlecoff and Kelly. The House Committee was Anderson, Laurence, Reigart, Cowden, Cromwell, Stokes and Derr. The Senate passed a bill which contained some of the provisions of the old pauper system law, and some of the features of the law of the previous session—a compromise measure, which was very objectionable to the friends of education by common schools. It was introduced in the House and considered by the House in Committee of the Whole on the 10th day of April, 1835, and reported with amendments, and came up for consideration the following day on second reading during the forenoon; was taken up again when the House met same day at 3 P M, and 7 P. M., and so determined were the friends of education to pass the bill with its amendments before adjournment, that the session continued some time after night, which resulted in saving a rational school law from defeat. It was on that occasion Thaddeus Stevens rendered the signal service which entitles him to be styled the Father of the System. He made, when the bill was under consideration, a very eloquent and powerful speech, and was unceasing in his efforts during the period, and I have no doubt saved the measure from defeat. Stevens had no taste for details; his position was the floor of the House. My impression is the intellectual labor consequent upon the preparation of the bills (except the Senate compromise bill of 1835), from first to last was accomplished by Samuel Breck, Dr. William Worthington, William Jackson, and Dr. Geo. Smith. The evening session was occupied by improper and counter motions. Conspicuous under this head were Henry W. Conrad and William Hopkins, but the friends of the system remained firm and united to the end. The Senate concurred in the amendments made by the House, which became the law.

Henceforth opposition to the school law, so far as petitioning for its repeal, ceased, and the friends of education were left in the quiet enjoyment of what had been obtained, and looked forward only to profiting by experience and perfecting the system. Accordingly, during the next session of the Legislature, that of 1835-6, a bill was reported to the Senate, prepared by Dr. George Smith, of Delaware county, chairman of the committee on education of that body, which became a law, and was styled the consolidated act.

Governor Joseph Ritner was the firm friend of the school system, as were also those persons connected with his administration. Thomas H. Burrowes was Secretary of State and State Superintendent of the common school system. Well do I remember his earnest zeal and untiring effort to diffuse knowledge on the subject and urge the acceptance of the law.

It is gratifying in conclusion to observe the change and upward tendency and improvement in sentiment on this subject since 1832, which has culminated in that grand provision in the Constitution of 1873 heretofore quoted, and which sustains a State Superintendent of Public Instruction and superintendents in every county in the Commonwealth, with the army of teachers having the seal of approval as such—an administrative measure dispensing an influence for good to every family within the length and breadth of the Commonwealth.

E. F. PENNYPACKER.

10th mo., 18, 1880.

## COMPULSORY EDUCATION IN BUFFALO.

THE compulsory educational law seems to be having a fair trial in the city of Buffalo, New York. We have before us the late report of the examiners, giving some valuable statistics and stating some valuable conclusions. From it we learn that in Buffalo the school registration is 23,201, of whom 18,041 are in public schools. The average attendance is 18,087. The following statement shows the work of the Truancy Department.

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|---|---|
| Number of cases investigated by the Examiner | 1,211 |
| Returned to schools | 370 |
| Non-attendants placed in school | 297 |
| Committed to Reformatory | 24 |
| Kept at home by parents | 265 |
| " " " sickness | 195 |
| " " " poverty | 60 |
| Number of arrests | 57 |
| Provided with books | 71 |
| Number of children between 8 and 14 years of age arrested by Police Department | 456 |
| Number of children between 8 and 14 years of age held or committed by Police Department | 242 |
| Number of cases investigated and not classed as truants | 520 |

The examiner says:

We are gratified to be able to report the growing usefulness of the department in securing attendance upon schools, as well as in restraning truancy and its consequence vices. Some embarrassment is still found by what we are constrained to believe to be imperfections of the law creating the department.

Among these may be mentioned the limitation of the time required for school attnedance to fourteen weeks during a year. The effect is found to be that children of truant age are inclined to roam the streets the remaining thirty-eight weeks, in defiance of the authority of the department.

Another is found in the want of suitable provision for the care and correction of refractory truants. In previous reports we have endeavored to impress upon the proper authorities the urgent necessity of the establishment of a Reformatory, Truant Home, or some other similar institution for this class of children.

It is useless to expect that the confirmed, contumacious, and incorrigibly vicious children can be successfully reclaimed, or even restrained, without the application of more effective measures than are now provided by law. It is unjust to the public schools and injurious to their discipline to enforce their attendance there until other corrective influences are resorted to for reformation.

A truant school or schools, such as are established in other cities, would seem to be the best plan which experience and observation have yet developed for this purpose. The urgency of this matter requires that no time be lost in providing for its needs.

The working of the compulsory law in Buffalo, as well as elsewhere, confirms us in the opinion that the work of education in our cities and large towns requires three things.

1. A law empowering the school boards to find out the children of school age not in school, and to arrest all vagrants, truants and neglected children who are growing up in ignorance and vice.

2. Suitable agents to carry the law into effect.

3. The establishment of a truant school or a home for neglected children, apart from the ordinary public schools.

## KINDERGARTEN.

THE following is a report from the Pittsburgh *Commercial* of the recent lecture on "Frœbelism, or the Kindergarten System," delivered in that city, by Rev. J. B. Bittenger, D. D., of Sewickley. It contains some good food for thought:

Dr. Bittenger in opening his lecture said there were three ideas possible in education. The first is that the teacher has something for the pupil; that the child is but an empty vase to be filled from the teacher's fullness. The second idea is that the child is an imprisoned angel which must be set free; that children are like blocks of marble, in which there are many possibilities, but that an artist is required to release the possibilities which are fettered by the crude bonds of nature. This theory credits the child with the possession of some valuable faculty, some talent awaiting development. Another idea is that the child is like an acorn, which the fructifying forces of the

earth cause to unfold, and seeking the sustenance of downward and upward growth, at last becomes the mighty oak.

Frœbelism starts with the idea that in the school-room there is nothing so valuable as the child himself. The child is more than all the furniture. The child is the product of God, and there can be nothing better. We may marvel at what God brings out of the acorn, but what is there in that compared with what God has hidden in the child? It can see what telescope and microscope never can see. It is capable of seeing color, form; and distinguishing sounds. With its five marvelous senses it can take in all that God has made. Every child has more in it than anything else that goes to make up education. Yet the child is as unconscious and as innocent of its unfolding as the acorn. Back of all the child's instincts there lies the power to make it unfold and develop. The child will learn to talk its mother tongue in two years, while it will take the man four to six years to learn to talk Latin. We can only unfold the child's mind according to the laws of nature. We can give the child a pole to climb on, but it must do the climbing itself. We mar it if we attempt to push it. It is this fact that the present system of education overlooks.

The child is a wide-awake creature, crammed with energies that clamor for something to do. God has put these energies there as he has put them in a vine. Frœbelism regulates these energies as a wise engineer regulates a waterfall. The æsthetical, physical and intellectual powers are taken under surveillance, and guided to the best ends. Frœbelism takes all these powers and puts them to work legitimately. For instance, the destructive or inquisitive talent in children is taken advantage of to reach an end. Give a child any object, and it at once tries to see the inside of it. It must be opened, even if the hammer must be used to open it. The Kindergarten recognizes this, and gives the child an unfolding cube, which interests it in satisfying its curiosity. But in addition to the analytic process, the kindergarten also teaches the synthetic process. After the child has taken to pieces the block given it for its amusement, it is taught the more difficult process of putting it together again.

In the school-room of to-day, what do you find takes the place of this irrepressible energy of the child? In most schools it can be seen in an uncontrollable swinging of the feet and moving of the body, and then when school is dismissed the children rush out of doors like a cannon shot. They have been deprived of their liberty so long, that when they get it they take it not moderately, but with an explosion like a cannon shot. What makes the children so happy out of school? It is liberty—the privilege to let off the extra steam which has been gathering in the school. The kindergarten is the only school which children cry to go to. It gives room for these energies, for the play of the immagination and for physical exercise.

The lecturer then proceeded to give an amusing description of the manner in which children are taught in the common schools, and illustrated the absurdities and difficulties of the ordinary methods of education of a child, contrasting them with the common-sense ideas of the Kindergarten. Against the plea of cost urged against the kindergartens, he brought the argument of added good derived from them, as compared with the ordinary methods of education. To the plea that women who have never had children are useless as teachers in a kindergarten because they know nothing of children, he said that the maternal instinct is strong in every woman. In conclusion he referred to a motto hanging on the wall back of him. "Come, let us with our children live," and argued that in that sentence lay the whole secret. They must not only live for their children, but live with them.

## NORMAL EXAMINATIONS AGAIN.

WE referred in the October *Journal* to some views expressed by Prof. Maris of the Normal School at West Chester, at the State Teachers' Association, on the subject of aminations at the Normal Schools. We have now his more formal views, as set forth in his annual report to the School Department. He says:

The present plan of examination by the State Board should, I think, receive considerable modification to adapt it to the needs of the different Normal Schools. The method of examining the graduating classes in all their studies of the course, at the close of the Senior Year, is very wearing on students, and productive of bad results in several ways. I am well convinced that it would be much better to examine in a part of the course, at the close of each year, thus encouraging concentration of effort, instead of an attempt to grasp so many studies at one time.

I submit the following as the best plan to meet the difficulty in this school, and I think with a slight modification it will be found practicable in all the Normal Schools of the State:

Let the law be so modified that, whenever students of Normal Schools, or practical teachers, have passed a satisfactory examination in any branch or branches, before the faculty of the school, they shall be eligible to enter the examination in said branch or branches by the State Board at its annual session, and if successful they shall receive a certificate exempting them from further examination by said Board in the branches thus completed, for the space of three years. If in the meantime they shall have completed all the branches of the Elementary Course, they shall be entitled to and shall receive the usual certificate of scholarship now granted to graduates in this course.

In our former article we showed that the evil of which Prof. Maris complains can be got rid of without any change in the present plan of conducting examinations at the Normal Schools, but if some change is desirable, it certainly is not the change proposed in the paragraphs above quoted. Indeed, we fail to see one single merit in it, and have come to the conclusion that Prof. Maris must have proposed it simply to awaken discussion. The objections to it are such as to render it entirely impracticable.

1. It provides for an examination of all the students in the schools. This alone would multiply the work of the Board of Examiners *tenfold*, as not one in ten of the students at our normal schools graduate.

2. It opens the way for practical teachers, not students, to be examined in any study or number of studies in which they may choose

to be examined. This would further increase the work of the Board, and for what purpose?

3. The certificates proposed to be given to those who do not graduate, that is, to more than nine out of every ten of the students, would be of no possible use to them in the way of obtaining schools, as they would still have to be examined by the superintendents; and it is very evident that one of the bad effects of such certificates would almost inevitably be a conflict between the superintendents and the Board of Examiners.

4. The Board would then meet, not as now for a definite purpose well understood, but to examine a miscellaneous assemblage of good scholars and poor ones, in one branch or more, as they might select. If they found any who had passed in the prescribed number of branches they could be granted diplomas, and the rest would receive certificates that they had passed in one branch, or two, or ten, or twenty, as the circumstances justified. A book would have to be kept showing just how far each one had advanced, and duly crediting the work of the successive examinations. The whole thing looks like trifling with a most serious and important matter.

## TEACHERS' INSTITUTES IN FRANCE.

BY a decree dated August 10, 1880, the Minister of Public Instruction in France, has directed the establishment of Teachers' Institutes, or, as he calls them, Pedagogical Conferences, in every canton or arrondissement throughout the whole country. The details of their management are left to local offices, but all teachers are required to attend and provision is made for the payment of their expenses, one-half by the government and the other half by the authorities of the department. This is an important movement, and is but one of many showing the wonderful activity in all that relates to the education of the people, that prevails at the present time in the French Republic. No nation in the whole world is doing more than France, if so much, to strengthen its system of public instruction. The French believe that it was the Prussian schoolmasters rather than the Prussian soldiers that beat them in the late war, and they mean to use their own schoolmasters in organizing the coming struggle that already begins to loom up on the distant horizon. They are spending vast sums of money on their armies, but they are even more liberal in their expenditures for schools. Their wisest statesmen begin to see that in its last analysis the problem of government consists in the problem of education, and that if the latter is solved the former will solve itself.

The decree directing the establishment of the institutes sets forth some good arguments in their favor and some directions as to their management, which have the same force in America as in France. We translate a few paragraphs as follows:

"It is important that our teachers should escape the influence of isolation which paralyzes little by little the strongest will. Young or old, educated in a normal school or otherwise, our teachers have need to make every effort to avoid being disheartened or falling into routine. To aid them, to keep each of them alive to their work, nothing can be better than the co-operation and conference of the whole body to which they belong, whose interest it is to allow none of its members to become enfeebled or to fall behind. In the periodical institute, teachers learn not only to discuss in common questions of method, points of doctrine, books and processes, and all the details of school organization; but they find there an opportunity of forming fraternal relations with their co-laborers, and of enjoying a closer communication with their leaders and the officers who direct them. That is to say, by meeting and acting together at an institute, they create among themselves that *esprit du corps* and that professional solidarity which are calculated to give them as a body dignity and power.

"There should be considered at these institutes only such matters as relate to education, theoretical or practical. The discussions should not be allowed to scatter out upon other subjects.

"It is desirable that the members of the institutes should study educational subjects mainly from a practical point of view. Too often, questions of education serve as a theme of vain declamation. Chimerical plans and empty and ambitious theories have heretofore compromised rather than advanced progress. Teachers should convince themselves that pedagogy is a positive science, which rests upon experience. May I not have the pleasure, also, of seeing the conclusions of the institutes reduced to practice, and illustrated by teachers in the classes from their schools before their fellow-members? Such exercises could be followed by discussions founded on observations taken from life. To enjoy in common the fruit of the educational experience of the members as a whole, to communicate mutually the little discoveries each has made in the school-room, to clear up by dis-

cussion not only the learned systems but the actual realities of the primary school, is the true end of a teachers' institute and the reason of their just popularity."

## OVER THE SEA.

LETTERS FROM THE EDITOR.—NO. XXVI.

### SOME DAYS IN HOLLAND.

FROM Berlin to Amsterdam is a long ride. We went by Stendal, Hanover and Zutphen. The country is well cultivated all the way, and possesses the usual German characteristics. The people live mostly in villages, and till the adjacent lands, which are laid out in small fields When separate, the farm houses and barns are generally constructed under one roof, and arranged, as is customary in other parts of Germany, around a court-yard in the form of a square. Now and then, however, you see farms with large fields and buildings, quite like those in the German sections of Pennsylvania. Many more of these are seen as we approach the western frontier. A notable feature of the landscape along much of the way was great flocks of sheep, and here and there of geese. Crossing into Holland, we found the country flat, the grass remarkably green, canals running in all directions, windmills everywhere, the farm-houses scattered as with us, generally built of brick, small and of one story in height. It was near midnight when we succeeded in finding our way from the station to the Old Bible House, Amsterdam, and retiring to our rooms for much needed rest.

Amsterdam is a fine old city, rich and prosperous, but not handsome. It once ranked as the first commercial city in Europe, pushing its trade into all parts of the world, and planting colonies in the East Indies, Africa, South America, and on the banks of the Hudson and the Delaware. The city is situated at the point where the Amstel empties into an arm of the Zuiderzee, and contains over 300,000 inhabitants. The *dam* which gave its name to the city was erected in 1204. Amsterdam is surrounded on the land side by a semi-circular wall, protected by a broad moat or canal, concentric with which, within the city, are three other large canals, called the Heeren Gracht, the Keizers Gracht, and the Prinsen Gracht. Besides these, there are seventy other canals intersecting the city in all directions, and cutting it up into nearly one hundred islands connected by some three hundred bridges. Many of the canals are bordered with avenues of elms, and fronting upon them are many handsome residences. The houses are not built so close to the banks of the canals as in Venice, and boats do not seem to be in general use on the canals for either business or pleasure. The foundations of the houses are piles driven down from ten to twenty feet through loam and sand to the firm earth. These piles must be constantly guarded from worms that threaten to eat them away, and the number of houses one sees out of perpendicular shows how insecure the foundations sometimes become.

The representative Dutch house in Amsterdam is very high and very narrow, with tall forked chimneys, steep roof and gable projecting towards the street. It is built of very small red bricks, and has white shutters. Along some of the canals the upper stories of the houses frequently extend out over the water, and are provided with pulleys for hoisting up weights. We saw many narrow streets and obscure alleys in Amsterdam—many of the abodes of the poor; but we saw no dirt, no squalor. The Dutch are emphatically clean and tidy. These remarks do not apply to the Jewish quarter, into whose uninviting purlieus we merely looked.

The harbor of Amsterdam, with its connected docks and canals, forms the centre of a trade that employs thousands of vessels and extends to all parts of the world. The scene as you walk along the quay is a busy one; vessels are coming and going, loading and unloading, sailors and merchants mingle together, and speech is a babble. You are struck with astonishment at the immense works that protect the city from inundation and give shelter to the shipping, and wonder at the industry and skill of the little country that wrests not only sites for her cities, but the land itself that constitutes her possessions, from the domain of the sea. At the end of one of the quays stands an old tower called the *Schreijerstoren*, or Crying Tower, from its frequent occupancy in by-gone times by the weeping relatives and friends of those who were about departing on their voyages. Not far from it is the house of the brave old Admiral de Ruyter, who, with Van Tromp and de Witte, were about the only European commanders that ever proved themselves able to cope with the English on their favorite element, the sea.

We visited the Palace in the Dam. It was built in 1648 for a town-hall, but was used by Louis Napoleon and his unhappy wife Hortense, while occupying the throne of the Holland. The arrangement of the apart-

ments, their furniture and fitting up, comport with the ideas of convenience and taste prevailing in this wealthy and powerful city more than two hundred years ago. Many of the rooms are adorned with fine sculptures and paintings. The Council Chamber is a splendid room, 117 feet long, 57 feet wide, and 100 feet high. The view from the Tower embraces the city, the sea, the surrounding country covered with gardens and farms, interlaced with canals, and studded with hundreds of windmills.

A half a day and longer can be profitably spent in Rijks Museum, particularly rich in pictures belonging to the Dutch schools of the two last centuries. Here are found two of Rembrandt's most celebrated pictures, the Night Watch and the Directors of the Guild of Clothmakers. These pictures are remarkably life-like and spirited. Van der Helst is well represented, as are Karel du Jardin, Paul Potter, Van Ruysdael, Jan Weenix and many others. It is a national gallery in the best sense, the pictures being mainly the work of their own artists. In the fine collection of engravings shown in connection with the paintings, we noticed sketches by Rubens, Van Dyck, Albert Durer, and others whose works do not appear in the museum.

From Amsterdam we went to the Hague *via* Gouda, and then to Rotterdam. This gave us a fair opportunity of seeing the Dutch at home, in both town and country. The first object that attracts the attention of the stranger in traveling through Holland is the astonishing number of windmills, that form a part of every landscape. At some points on certain lines thirty may be counted at a single glance from a car window. Many of these windmills are very large, a single sail sometimes being more than sixty feet in length, and therefore sweeping a circle nearly four hundred feet in circumference. They stand on the ramparts of cities, on the bastions of forts, on dykes, embankments and mounds, raised for the purpose. They are used for grinding grain, sawing timber and manufacturing of various kinds, but their principal object is to pump up the water from the low ground to the canals that carry it to the sea. The sea breezes which prevail in this country keep them in almost constant motion, and they thus accomplish an immense amount of work. The lower stories of the windmills are frequently made use of for storehouses and dwellings. Canals are about as common in Holland as fences are in Pennsylvania. They vary in width from a few feet to over a hundred, and in depth from four feet to twenty. They are used as public highways, and vessels are seen upon them in number and variety, equal to the conveyances that pass along our most frequented country roads. They serve also as enclosures for houses, fields and gardens; and, as they are generally straight, they frequently divide whole farms into squares and rectangles It adds to the novelty of this arrangement that the canals are often enclosed by embankments from two to twelve or fifteen feet higher than the surrounding country, and bordered by avenues of trees. But the main purpose for which this wonderful system of canals was constructed is to carry off the superfluous water from the cultivated land. The greater part of Holland, as is well known, is many feet below the level of the sea. The whole coast is defended by immense dykes, and a constant war has raged for hundreds of years between the brave, industrious Dutchmen determined to conquer a place to live and thrive, and the angry waves intent upon devouring them. Hitherto, the victory has been on the side of man against the sea, and the fairest part of all Holland has been wrested from the domain of King Neptune. But while the Dutchman fights his enemy in front the very means he takes to do it creates a not much less formidable enemy in his rear, and the elaborate system of canals and hydraulic apparatus he has devised to save his property and himself from being drowned out is the result.

It was in September when we ran through Holland, but the grass was as fresh and green in the fields as ours in May. It is a paradise for cattle. The fields were full of them—some of the herds as fine as any I have ever seen. Dutchmen seem to think as much of their cattle as Arabs do of their horses, and their wives, it is reported, have their favorite cows sleep in their best beds; and we ourselves can vouch for the fact that the stables in which they are fed and milked form frequently a part of the house, and are kept about as clean. The ordinary farm houses of the country are constructed of brick, one story high, and generally very plain. Everything about them is remarkably clean and tidy, but we would say the people lack taste for the higher kind of household ornamentation. Now and then, however, you see fine country-seats, approached by long avenues bordered with trees, and surrounded by well kept gardens and parks. The people of Holland seem healthy, are rather stout, generally fine-looking, always ready to talk, and smoke incessantly. In most countries in Europe there are certain

cars on all trains in which smoking is not allowed; in Holland, all seemed alike full of smokers and smoke. The passengers fill their pipes the first thing after taking their seats in the car, and at once look around for some one to talk to; and then smoke and talk, and talk and smoke, to the journey's end. The working people all wear wooden shoes, and wagon-loads of all sizes of such shoes are for sale at the stores in the cities. The men generally wear blouses as in France, and the women aprons and white caps. The peculiar costumes often worn, both by men and women, in particular provinces, are beyond my powers of description, but they add an element of picturesqueness to the rural scenery. Withal, the Dutch are intelligent, liberty-loving and prosperous. In scientific, educational and charitable institutions they are among the foremost people of Europe, thanks to their own stern virtues and the wise rulers who have governed them.

We reached the Hague the day after the return of Prince Henry, the King's brother, with his bride, from Berlin. The marriage took place, as we stated in a former letter, while we were in that city. The capital was still gay on account of the happy event. Prince Henry seems to be a great favorite, while the King himself is heartily disliked. Flags and streamers were flying everywhere, banners hung across the streets, rich drapery adorned the fronts of the houses, evergreen arches spanned the public thoroughfares, in the public squares arose massive columns and pyramids of flowers; the music had not yet ceased in the parks and gardens, and crowds of people dressed in holiday attire still promenaded the streets. We did not have much time to enter into the spirit of these festivities, but hastened to employ the few hours we had at our disposal in taking a look at the city. The Hague is not a city of trade like Amsterdam and Rotterdam, but rather, a city of pleasure and fashion. It owes its importance to the residence of the King and Court and to the meetings of the States-General. The newer part of the city is handsome, with fine houses, extensive squares, and broad, well-shaded avenues. From the station we at once directed our steps to the *Binnenhof*, near the centre of the city, in the neighborhood of which we knew we would find what most interested us. The Binnenhof is an irregular pile of buildings, some of them very old and quaint, surrounding a large court. The States-General meets in the Binnenhof, and it contains also the several municipal offices. In the Court stands the Hall of the Knights, a brick building, chapel-like, with pointed gables and two turrets, erected in the thirteenth century. It very appropriately contains the Government archives. Here, too, was placed the scaffold, on which was put to death the brave and honest John van Oldenbarneveld, by the orders of Prince Maurice of Orange, an event which stirred the hearts of liberty-loving people throughout the kingdom to their foundations. From the Court of the Binnenhof we passed into the *Plein*, a square near by, that we might see the statue of Prince William of Orange, erected, as inscribed on the pedestal, by "The grateful people to the father of their Fatherland." The statue is of bronze, and is considered an excellent representative of the world-renowned "Silent Man." A statute of William II., stands in the *Buitenhof*, another square on the opposite side of the Binnenhof. Bordering on the Buitenhof is the *Vijver*, a beautiful sheet of water with an island in the centre, enlivened by swans, and surrounded for the most part by broad, well-shaded avenues, on which stand the finest houses in the city. An old tower with a gateway, called the *Geavengenport*, leads in a northern direction from the Buitenhof to the *Plaats*. Here, in 1671, the brothers Cornelius and John de Witt, noted in Dutch history, the latter on a visit to his brother who was in prison, were set upon by the infuriated populace, who had been induced by their enemies to believe that they had conspired against the life of the Stadtholder William III., and literally torn to pieces.

From the Hague to Rotterdam the distance by rail is only fifteen miles. We ran into the city on a splendid iron viaduct above the tops of the houses, and found comfortable quarters at the New Bath Hotel, looking out upon the Meuse.

Rotterdam contains 140,000 inhabitants, and its site upon the Meuse, with arms extending far within the city, and branching off into canals that intersect it in all directions, gives the place commercial advantages possessed by few cities in Europe. The harbor is always filled with water craft; one hundred steamboats ply between Rotterdam and other cities, and great ships from foreign lands discharge their cargoes in the very heart of the city. Rotterdam, indeed, has more the air of American stir and thrift than any city we had visited. In fact, a great many of the people are English, and English stores and commercial houses are numerous. At our hotel at least three-fourths of all the guests were either English or American. And, as a

whole, it may be remarked that the Dutch are more like the English than any other people on the continent.

Our hotel was on the *Boompjes*, a handsome quay a mile in length, along the Meuse, planted with trees and overlooking the harbor; and our first walk was up and down it. We saw much that interested us, but the sight that touched us most was a ship that bore at its masthead the flag of our country—the stars and stripes. An immense dyke runs through the centre of the city to protect the quarter behind it from the tide, and on this runs a street called Hoogstraat. This we followed perhaps for a mile, observing the city life, and comparing it with the life in our cities at home. We visited the Exchange, a very plain building, enclosing a court covered with grass. In the *Groote* Market, a short distance from the Exchange, stands the bronze statue of Erasmus. He is represented holding an open book in his hands before him, over which he bends with an air of deepest thought. The statue was erected by citizens of Rotterdam, in 1662. The statue of the learned Reformer scarcely interested us more than the lively traffic of the market people that was going on aronnd it. The marketing, which consists mostly of vegetables, is brought to the market-place in boats; and the work of unloading, arranging, selling and buying, was in so many ways different from anything of the kind we had ever seen at home—the costumes of the peasants were so novel—the language was so odd—that we watched what was going on with much interest for a long time. Then we lost ourselves in the narrow, crooked streets, and wandered up and down, drifting about with the crowds of people as they came and went, until, weary with this kind of sight-seeing, we called a carriage, and were soon resting in our hotel.

On Tuesday, September 3d, we set out for Paris and the great Exposition.

# OFFICIAL DEPARTMENT.

## COLORED CHILDREN.

OPINION OF SUPERINTENDENT OF PUBLIC INSTRUCTION, IN THE MATTER OF SEPARATE SCHOOLS IN ALLEGHENY CITY.

DEPARTMENT OF PUBLIC INSTRUCRION,
HARRISBURG, *November 12, 1880.*

DAVID L. SMITH, Esq., *Secretary School Board, Third Ward, Allegheny:*

DEAR SIR: At the time the questions submitted to me by your board came into my hands, I was so severely pressed by engagements connected with the business of my Department, that I could not immediately give them the attention that I thought their importance deserved, nor was I in possession of all the facts that I deemed necessary to a full understanding of the case. Besides, I was not without hope that a little delay would be calculated to lessen excitement and remove prejudices, if not to enable the school authorities of the city to adjust the difficulty for themselves. This hope was in good degree well founded, for at the late meeting of the Board of Controllers, held November 9, the question at issue was, at least for the present, practically settled, and nothing remains for me but to give, for future guidance to your board and to others who have addressed me on the subject, my opinion as to the requirements of the law relating to the case.

Changing, somewhat, the form of the questions submitted by your board, but retaining their substance, and connecting with them some inquiries coming from other quarters, the whole subject may be covered in answers to the following interrogatories:

1. Have the School Directors of a ward in the city of Allegheny a legal right in any circumstances to establish a separate school for colored children?

2. Can the Board of Controllers of the city of Allegheny, under the laws relating to the subject, be compelled to establish and maintain a separate school for colored children?

3. What effect has the Fourteenth Amendment to the Constitution of the United States on State laws providing for the establishment of separate schools for colored children?

These interrogatories will be answered briefly in the order presented:

1. It is clear to me, that the School Directors of a ward in the city of Allegheny have no legal right in any circumstances to establish a separate school for colored children. This right, if it exists at all, belongs manifestly to the Board of Controllers, and not in any case to the ward board. Section 21, act of May 8, 1854, provides, "that the directors or controllers of the several districts of the State are hereby authorized and required to establish, within their respective districts, separate schools for the tuition of negro and mulatto children;" but it is to be noticed that it is the directors or controllers of "*districts*," and no others, that are entrusted with this power; and a school district in Pennsylvania is a city, borough or township—never a ward. Allegheny city, as a whole, is a district—the Third Ward is not a district—in the legal sense of the term.—See Section 1, act of May 8, 1854.

Besides, the ward boards in Allegheny, and in other cities with a like school organization, "exercise in

their respective limits all the powers and duties of school directors as regards the erection or repairing of school-houses and lots;" but these powers are entirely taken away from them in respect to separate schools for colored children. A ward board cannot levy a tax for the erection of a building for a separate school for colored children, and cannot use the public money in any way to provide such a building. A provision in the law in relation to separate schools for colored children, enacts, "that in cities and boroughs the Board of Controllers shall provide for such schools out of the general funds assessed and collected by uniform taxation for educational purposes." The reason of the adoption of such a provision, is doubtless the fact that it was expected that ward lines would have to be in a measure disregarded in the establishment of separate schools for colored children, and that, in consequence, the only fair way to provide for such schools, was by the "Board of Controllers," "out of the general funds." But whatever may have been the reason, it is as certain as it can be that ward boards have nothing to do with the matter. The law expressly and purposely takes it out of their hands.

2. As to the duty of the Board of Controllers of Allegheny City in establishing and maintaining separate schools for colored children, the law already partially quoted appears at first sight to be mandatory. It sets forth, "That the directors or controllers of the several districts of the State are hereby authorized and required to establish, within their respective districts, separate schools for the tuition of negro and mulatto children, whenever such schools can be so located as to accommodate twenty or more pupils." But when closely analyzed, it will be found that the statute is by no means absolute in its requirements. It still remains a question for the Board of Controllers to settle, whether such schools or such a school can be so located in Allegheny City "as to *accommodate* twenty or more pupils;" that is, *furnish them educational facilities of all kinds equal in every way to those provided for white children.* If compelled to attend a separate school, would not the colored children be forced to walk a longer distance than the white children are forced to walk? If so, the injustice would be warranted neither by our State laws nor by the Constititution of the country. Could a separate school, with a probable attendance of a small number of pupils of widely different ages and acquirements, be as well graded, as well classified, as effectively taught, as the schools for white children? If not, then it cannot properly "*accommodate*" them in the sense of the law, and the Board of Controllers cannot be compelled to establish and maintain such a school. After careful consideration, therefore, my opinion is that it is the duty of the School Controllers of Allegheny City to establish and maintain separate schools or a separate school for colored children, if it can be done strictly under the law, as herein construed, without abridging in any way the equal educational rights and privileges of the colored children who may become pupils; but that they cannot be compelled to establish and maintain such schools or such a school, should the act do injustice to any child or body of children, or render their opportunities of receiving an education unequal to those of any other child or body of children. The question as it stands under the law is clearly one of discretion on the part of the Board of Controllers, one for the exercise of their own best judgment, and it will without doubt be so considered by the courts if brought before them, following numerous precedents in cases appertaining to the powers and duties of school directors. If, then, the Board of Controllers abolished the colored schools heretofore existing because they thought they did not "accommodate" the colored children of the city as they ought to be accommodated under our laws, their action was not only just, but legal, and they cannot be compelled to re-establish them unless the circumstances so change as to warrant it.

It should be added that, in the absence of schools especially provided for them, colored children must be admitted into existing schools on precisely the same conditions as white children.

3. The Fourteenth Amendment to the Constitution of the United States, providing that "No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States," is held by some good authorities to nullify all State laws requiring the establishment of separate schools for colored children. The question has not been decided by either the Supreme Court of the United States or of Pennsylvania. The Supreme Courts of New York and Ohio, however, have rendered decisions affirming the constitutionality of such laws, provided *the schools established under them afford educational advantages equal in all respects to those established for white children.* These decisions possess great weight, and what I have herein written is based upon the assumption that they are sound.

Yours, respectfully,

J. P. WICKERSHAM,
*Supt. Public Instruction.*

## EXAMINATION OF SCHOOLS.

TO SUPERINTENDENTS: Accompanying this circular you will receive a copy of the "Report of Examinations of Schools, in Norfolk County, Massachusetts, by George A. Walton, Agent of the State Board of Education." A hundred copies of this Report have been obtained from the publishers at considerable expense by the Department of Public Instruction, for distribution among the superintendents of schools in our counties and cities. It contains a series of tests applied in the schools of Norfolk County, Massachusetts, to ascertain the acquirements of the pupils in reading, writing and arithmetic, together with tables showing the results obtained, and in some cases fac-similes of the work. The investigation was set on foot by an association of the school committees and superintendents of Norfolk County, and seems to have grown out of a conviction that the public schools of that section of the country were not accomplishing all that could reasonably be expected of them. The examinations, as stated in the report, brought to light "lamentable ignorance" on the part of the children in the schools; and yet the committee say they "believe that the results are as good as can be obtained in any other county of Massachusetts, or, indeed, of any other State, when similar tests are applied in a similar manner." And further, they almost challenge a comparison by urging, that "if any school authorities elsewhere doubt the truth of this statement, let the experiment be tried in the schools of their county," Now, the public schools of Pennsylvania ought to show better results than those exhibited in this report. *Do they?* Our children ought at least to be making fair progress in learning to read, write and cipher; *how does this matter stand?*

This Massachusetts report has been obtained, therefore, and is now placed in the hands of all the superintendents in the State, in order that "similar tests" may be applied in the schools under their charge "in a similar manner," and that the results may be carefully tabulated and preserved. With this view Superintendents are respectfully requested—

1. To read the report carefully.

2. To provide tests similar to those used in Norfolk County, confining themselves at first to reading, writing and arithmetic.

3. To apply these tests fairly on their visits to schools.

4. To tabulate the results and preserve the manuscripts.

5. To report the result, if called upon.

In some counties it may be impracticable to do more than to examine in this way a single class in each school, but from one the whole can be judged. The age of the pupils should be taken in all cases. A superintendent had better omit the general examination of the school at his visit this year, if it is necessary, in order to make the test now to be applied. If the results be used for no other purpose, they will be of great value to the superintendent himself in imparting instruction in methods of teaching. The closing words of the committee in presenting the report are to us very significant: "We have pointed out the DEFECTS; the REMEDY is *intelligent supervision* by skilled superintendents." Massachusetts has no county supervision.

J. P. WICKERSHAM,
*Supt. of Public Instruction.*

## COUNTY INSTITUTES.

The following is the list of County Institutes to be held during the month of December:

| | | |
|---|---|---|
| Lehigh, | Allentown, | Dec. 6, " |
| Mifflin, | Lewistown, | " 13, " |
| Lackawanna, | Scranton, | " " " |
| Clearfield, | Clearfield, | " 20, " |
| Union, | Mifflinburg, | " " " |
| Lycoming, | Muncy, | " " " |
| Forest, | Tionesta, | " " " |
| Fulton, | McConnellsburg, | " " " |
| Dauphin, | Wiconisco, | " " " |
| Luzerne, | Wilkes-Barre, | " " " |
| Schuylkill, | Pottsville, | " " " |
| Huntingdon, | Huntingdon, | " " " |
| Northumberl'd, | Sunbury, | " " " |
| Clinton, | Renovo, | " 21 " |
| Armstrong, | Kittanning, | " 27, " |
| Beaver, | New Brighton, | " " " |
| Blair, | Hollidaysburg, | " " " |
| Butler, | Butler, | " " " |
| Cambria, | Ebensburg, | " " " |
| Centre, | Bellefonte, | " " " |
| Elk, | Ridgway, | " " " |
| Fayette, | Uniontown, | " " " |
| Monroe, | Stroudsburg, | " " " |
| Montour, | Danville, | " " " |
| Westmoreland, | Greensburg, | " " " |
| York, | York, | " " " |
| Somerset, | Somerset, | " " " |
| Jefferson, | Brookville, | " " " |
| Clarion, | Clarion, | Jan. 3, 1881. |

# MISCELLANY.

## EDUCATIONAL NOTES AND PERSONALS.

SUPT. DICKSON, of Allegheny, has associated with him Prof. J. W. Caldwell, and will open an Academy of advanced grade in Pittsburgh about April 1st, 1881.

Beaver county has quite a number of young teachers this winter. Many of the older teachers have left the work, or gone to other counties at better salaries.

The principal of the Bedford schools this season teaches the primary department. This is a new departure, and should result in good.

The schools of Hollidaysburg, Blair county, have been closed temporarily, on account of the prevalence of scarlet-fever.

Supt. Stephens, of Blair county, writes that a number of townships have increased the wages of teachers, and two districts, Antis and Blair, have each added one month to the term of school. This is certainly evidence of good work and improvement.

The Doylestown Seminary, under the principalship and management of Prof. Winters, is in a flourishing condition.

Supt. McKee, of Butler county, reports a number of new school-houses in readiness for the opening of the "fall term" of school.

The borough of Johnstown has a new public school building in prospect.

The school board of Spring township, Centre county, have been ordered to appear before the Court of said county in November, to give reasons for not erecting a new school-house in a certain part of said township, in order to provide proper school facilities.

Spring City, Chester county, has a handsome school building of cut stone, ready for winter term. A substantial improvement, and one in which the citizens take much pleasure.

Supt. Davis, of Clarion, has prepared a series of questions in the several branches taught in the public schools of said county, and distributed them among the teachers. The questions will be submitted to the pupils of the schools in December, and the scholars' work in manuscript will be exhibited at the County Institute.

Supt. McQuown, of Clearfield, has prepared a course of study for the schools of his county, a copy of which has been placed in the hands of each teacher He says he expects to find teachers using the "course" when he visits the schools. He has also published directions and suggestions to accompany the course of study, all of which, it is hoped, will prove of great advantage to the teacher.

Boards of School Directors can secure better teachers in many localities if they will increase the length of the school term, and "raise the wages."

The Normal graduates teaching in the county of Cameron have organized a society for their improvement in science and literature.

In Clinton county, all the teachers who hold certificates will get schools.

Supt. Chamberlain says there will be less "boarding 'round" in Crawford county this winter than heretofore. The teachers will be glad when that custom is abolished, not only in Crawford, but wherever it exists.

The Board of School Directors of Hummelstown, Dauphin county, have placed Mitchell's New Outline Maps in their schools.

Superintendent La Ross, of Dauphin, says that lyceums and teachers' institutes are established in many of the school districts. These meetings are largely attended, and are creating much interest.

Superintendent Stewart, of Delaware, has furnished each director and teacher with a course of study for ungraded schools. Many of the teachers are using the course of study, without awaiting the action of the school boards.

Guilford township, Franklin county, during the past month, completed a new school house and furnished it with the Fashion Desk.

Superintendent Hoge, of Greene, says the directors of Centre, Greene and Washington, have furnished a number of the school houses under their control with the Triumph Desk, adding much to the comfort of the pupils and the pleasant appearance of the schools.

A new school building has been erected to accommodate the graded school of Bellevue, Jefferson county.

Juniata county has six new school-houses ready for occupation for the fall term of schools. The houses are generally well located, surrounded with ample grounds for exercise and play, and furnished with new and improved desks.

Superintendent Knauss, of Lehigh, reports the building of a number of new school houses, and the establishment of several new graded schools for the accommodation of the pupils in villages and rural districts. The month has been one of active work among the teachers and directors of the county.

The school Board of Lehman district, Luzerne county, is erecting a new house with the intention of establishing a central graded school. The movement is a commendable one.

Superintendent Curtis writes that McKean will have 160 schools open during the winter term. In the last annual report the county is credited with 109.

Miss Mary McCord, formerly principal of the public schools of Lewistown, is going to Panoma, and will there continue her work as teacher. Prof. Cope succeeds her as principal at Lewistown.

Montgomery county has increased the wages of teachers in a number of the townships and built and refurnished a number of school houses.

Prof. Kelso, principal of the Academy at Danville, has a flourishing school numbering about 50 pupils. The design of the school is to prepare pupils for college, and afford opportunities for a general course of study.

Newport, Perry county, high school has increased in numbers, and the Board of Directors have employed an assistant teacher in that room.

St. Clair borough, Schuylkill county, has authorized the principal of their schools to visit each school at least twice each month.

Susquehanna county has reported a larger number of schools open for the fall term than ever before. Lathrop township has opened a new graded school at Hopbottom.

Prof. F. M. Smith, the active principal of the Blossburg schools, in Tioga county, is adding books to the school library.

Hartley township school board have raised the salaries of all their teachers, grading salary according to certificate held by the teacher. The result is a better class of teachers than heretofore.

Superintendent Prather, of Venango, says the exhibition of scholars' work at the County Institute was an exceedingly interesting feature.

The schools of Warren, Tidioute and Youngsville, are making a good beginning, and promise to do better work than heretofore. A number of new houses have been erected in the county, and were ready for the fall term of school.

Superintendent Larrabee, of Wayne, says he holds himself in readiness to attend Institutes every Saturday from now until the close of the schools in the spring, if desired, and for this reason will name the first Monday of each month as office day.

Superintendent Williams, of York, says that the teachers generally are making efforts to introduce the course of study prepared for the ungraded schools of the county.

In Westmoreland educational affairs are progressive. The schools receive much attention from the directors and patrons. There are now 380 schools in the county. Superintendent Spiegel is bringing about a closer system of classification, by having a course of study introduced into the ungraded schools. Much interest is manifested by teachers, directors and patrons in local educational meetings, which are held in many of the townships. At these gatherings not only the teachers, but also the directors and patrons, take an active part in the discussion of live educational questions. The Superintendent is resolved that none but competent, professionally inclined, and heart-in-the-work teachers shall be granted certificates. The surplus of applicants is, therefore, less than in any previous year. For the 380 schools there were granted 441 provisional certificates. Westmoreland puts a premium upon professionally-trained teachers. 350 of the 520 applicants examined attended normal schools. The teachers of the county have been greatly encouraged by the progressive spirit of the directors. Many townships increased wages as well as length of school term. Nearly every township is giving its teachers a week to attend the county institute.

There is pressing demand in Chester for good teachers. Several schools are now closed because directors are unable to procure properly qualified teachers. Many districts have advanced salaries $2.50 to $5.00 per month. The institute recently held was attended by 354 of the 360 teachers in the public schools of the county. The whole number of teachers in attendance, including private schools, was 401. Fifteen premiums were awarded to pupils in drawing, penmanship, and other written work. The course of study proposed by County Supt. Harvey was unanimously adopted by the directors in convention.

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### SCIENTIFIC NOTES.

It is estimated that $11,600,000 are expended annually for quinine.

In making the St. Gothard Tunnel, 320,000 holes were drilled, 980,000 pounds of dynamite used, and 1,650,000 drills worn out.

An insect which produces a kind of India-rubber has been discovered in Yucatan, Central America. It is a species of *coccus*.

It is reported that a method of obtaining artificial

indigo has been discovered by Baeyer. The indigo is obtained indirectly from benzole.

A new machine for making railroad spikes has recently been invented, and is in successful operation in Pittsburgh. Five of the machines, by working "double time," have made 1100 kegs of spikes a day, each keg containing 150 pounds.

It is said that 18,740,800,000 pins are made yearly in the United States. Pins are made a thousand times more rapidly than they were fifty years ago.

The recent census of New Zealand shows that the Maories, or primitive inhabitants, are rapidly decreasing, their number having diminished from 55,334 in 1861, to 43 595. This national decay is said to be due to love of drink, bad food and clothing, neglect of cleanliness, and unwholesome dwellings. The decay of the Hawaian nation is still more rapid, their number having decreased from 57,125 to 44,088 in twelve years.

The best diamond-cutting in the world is now done in New York. The Dutch were for a long time masters in this work, and the most valuable stones were sent to Amsterdam to be cut, but now diamonds cut in Amsterdam have been sent to New York for recutting. The Dutch, in cutting, have hitherto aimed to remove as little of the gem as possible, while the American plan is to be governed by the laws of light so as to secure the greatest brilliancy.

It is said that the present wheat crop of California, will amount to 900,000 tons. Captain Eads says of the wheat region of that state: "I have seen sixty horses attached to ten machines, all at work cutting grain on a farm of 6,000 acres. I passed twenty-two miles of fencing which enclosed Dr. Glenn's wheat farm of 45,000 acres, and yet the production of California in wheat alone has not attained one-quarter of what it will be." The wheat raised in the State of Oregon this year will amount to more than 200,000 tons.

A German geographer has recently found that the highest mountain on the earth is the Sisbut peak, and not Dhawalagiri, which has long been regarded as the highest. The height of Sisbut is 27,799 feet and that of Dhawalagiri, 26,680 feet. Both peaks are in Nepaul. The highest places inhabited by man are in Thibet, at an elevation of between 14,800 and 15,000 feet.

The experiment of transmitting reports of debates in the House of Commons by telephone has been successfully tried by the London *Times*. The notes made by the reporter are read into the telephone receiver and are heard by the compositor, who sits with an ear near the office instrument. The rate of transmision of the messages is governed by signals.

Mr. Robert P. Porter, in his report to the Census Bureau on industrial statistics, gives some interesting facts in regard to the great States west of the Mississippi River. They were far beyond the reach of civilization three-quarters of a century ago. Chicago was only an Indian name for a small river, and St. Louis was an insignificant trading-post in the wilderness. Now the ten States constituting the great West contain 17,260,214 inhabitants, have two hundred thriving cities, and are netted with a great system of railroads. Their aggregate wealth is reckoned $11,000,000,000, and the annual produce of their farms amounts to $1,500,000,000. During the last fifty years the population of this section has nearly doubled, and its wealth has more than doubled.

Before the beginning of the eighteenth century opium was imported into China as a remedy for dysentery. Opium smoking, now so common throughout the whole empire, began in the latter half of the seventeenth century. Edicts against this use of the drug have been issued at different times; but the evil is now greater than ever, and is rapidly increasing.

M. Mouchat is experimenting with a solar engine in Algeria. With a concave mirror about twelve feet in diameter, he concentrates the sun's heat on a boiler, and obtains a steam pressure of 120 pounds in about an hour. The heat is utilized for distilling essences, boiling oils, and other purposes.

It has been recently discovered by Prof. Bell, inventor of the Bell telephone, that light is capable of transmitting articulate sounds. The instrument by which this is effected is called a photophone. The voice is directed against the back of a silvered mirror of flexible material, as mica or microscope glass, and light vibrating from the reflecting surface is received at the distant station on a parabolic reflector, in the focus of which, and also connected with a telephone, is a piece of brass coated with selenium. It is probable that conversation can be thus carried on between any two stations, however distant, between which light can be flashed.

Charles D. McGuffey, of Chattanooga, has been endeavoring to "get some idea" of the magnitude of the National debt at the close of the war. He has made the calculation that if four men were to sit down to pay the interest, and count a silver dollar a second, and work every second of the year, they could not keep down the interest on the original debt; and if another should sit down at two years of age to count the principal at the same rate, he would be over 107 years old by the time he counted the last dollar, interest on the principal having ceased from the first moment. The pile of silver dollars, moreover, which he would make in counting that principal would be four feet square, and fifteen times as high as Lookout Mountain (1,600 feet above Chattanooga); and if the silver were conveyed in a continuous wagon train, each wagon carrying a ton, and each wagon and team occupying thirty-five feet, that train would stretch from Chattanooga to Columbus.

At present rates of emigration it is calculated that Europe sends annually to this country five hundred million dollars worth of capital-creating force in the shape of emigrants. Ten million emigrants have some here since 1834, and we shall not begin to feel crowded for a hundred years to come, if emigration chould be kept up at the same rate. There is an empire in Texas alone that can support a population equal to that of Germany.

Several interesting facts in regard to the violin were recently given by Mr. Haweis in a lecture at the Royal Institution, London. After speaking of the great variety in the shape and style of violins, the lecturer referred to the wood of which they are made. "The old makers of the instrument selected the wood with great care. At Brescia, pear, lemon, and ash were used; at Cremona, maple, sycamore, and pine. The makers tested the wood by cutting srrips from the violin timber and striking them. A good maker will patch and join and inlay, to retain every particle of tried timber. "Old wood is oddly vocal; as I sat in my room, surrounded by these instruments, I could not cough or move without ghostly voices answering me from the sixteenth, seventeenth, and eighteenth centuries. The violin is made of fifty-eight or seventy pieces. It is a miracle of construction; as light as a feather and as strong as a horse."

"END THERE IS NONE TO THE UNIVERSE OF GOD: LO, ALSO, THERE IS NO BEGINNING!"

Why did not somebody teach me the Constellations, too, and make me at home in the Starry Heavens, which are always overhead, and which I don't half know to this day?—Carlyle.

# STAR-CLUB-PAPERS-AND-STAR-LIST.

## PAPERS READ BEFORE THE STAR CLUB OF THE YOUNG MEN'S CHRISTIAN ASSOCIATION.

THE following papers, more or less exhaustive of the several subjects treated, were read at successive semi-monthly meetings of the Star Club, in the audience hall of the Young Men's Christian Association of Lancaster, Pa., during the autumn and winter of 1879-80. The first hour of each meeting of the Club was occupied by a review of the list of Fixed Stars and Constellations previously given on the blackboard, and identified in the heavens by the aid of simple diagrams and a numbered Star List. Ten or more Stars and Constellations were added to this numerical list at each meeting of the Club so that in the course of its twelve meetings, a list of one hundred and twenty-five Fixed Stars, in their respective Constellations, had been so given as to be readily identified in the evening sky by the hundred or more members in attendance. Through the publication of the proceedings of the Star Club by the local press, a wide-spread feeling of interest was aroused in this grandest of all material sciences—the study of the stars. The series of papers, as here given, opens with a highly interesting discussion of "The Sun," by Mr. J. D. Pyott, in which nearly all that is known of this stupendous orb, the flaming centre of our system, is presented in brief but comprehensive form. It closes with an admirable paper on "Light and Eclipses" by Miss Mary Martin, of St. James' School, Lancaster. Between these papers we have, in succession, the Moon, the Interior Planets, the Exterior Planets, Comets and Meteors, the Nebular Hypothesis, and the Circle of the Zodiac—each subject having been specially assigned, by vote of the Club, to the member by whom it is here discussed. In their preparation it was necessary to consult the latest and best authorities on the various subjects named, so as to present the most approved results of the astronomer's work. These papers are, therefore, the substance of many text-books, and upon their uniform excellence the Star Club has good reason for congratulation. During the course of the meetings the distinguished author and scientist, Prof. Richard A. Proctor, lectured before the Club in Fulton Opera House, on the "Poetry of Astronomy." Bishop Warren, author of "Recreations in Astronomy," also lectured before the Club, in the same place, toward the close of the course. Both these lectures were grandly illustrated with the aid of the oxy-hydrogen light. The Star List, which was continued from time to time, by Mr. J. P. McCaskey, follows the papers. So that almost the entire work of the Club is here placed in the hands of teachers who may desire to know the stars for themselves, and to arouse an interest in this delightful subject in the minds of their pupils.

## THE SUN.

BY J. D. PYOTT.

THE Sun is our life. Without him the history of the human race would be brought to a close more summarily than even in Byron's "Dream of Darkness." Deprived of his light, a single day would precipitate all moisture from the air; in another day all our remaining heat would be radiated into space; and before the close of the third, all forms of life with which our senses are acquainted, our own included, would cease to exist, and the earth would roll through space a frozen tomb. There is no extravagance in the words of the French poet,

> "Life is thy presence, and thy absence death;
> Nature without thee, is the universe without God."

SUN-WORSHIP.—In the twilight that preceded the dawn of history, the human mind had already wrought out for itself the same idea, and from the mists of the morning the Sun emerges as an object of human worship, shining more or less clearly through all the earlier mythologies, and traced even in the later ones; for Indra, Baal, Zeus, Odin and Jupiter, are all the children of the Sun-god of earlier times. The religion of nature always turned its face towards the god of day: separated by centuries and by pathless oceans, Aryan and Aztec, Parsee and Peruvian, united in the worship of the Sun. Man, the youngest child of nature, enjoying the beauty of the world about him with keen senses, unblunted as ours by generations of comparative disuse, and ignorant of his own origin, recognized in the dazzling glory above him the giver of all his blessings, and by a crude analogy referred his own existence to what seemed the universal cause, and bowed in adoration to the grandest visible manifestation of Deity. Shall we condemn him? We look abroad upon our own enlightened age, and see on the one side philosophy eliminating God from the Universe and finding in matter the potencies of life; and on the other the masses of men, Christian and heathen nations alike, sunk into idolatries beside which the old, simple, natural worship rises into dignity. Primitive man looked up to his God; these look down. Sun-worship was the culmination of natural religion; and if the philosophy that rejects other revelation than that of nature should prevail among men, the instinct for worship will make itself a God from the life-giving solar ray, and the old type will be revived. "There is nothing new under the Sun."

It would be interesting to trace the Sun-myth through the changes of centuries; to see how, on the one hand, the thoughtful few attained the development that separated God from matter, and the Sun became first the throne of Deity and the home of the immortal spirit, and afterward but one of a host of his creatures; and how, on the other, the Sun-god was lost in a crowd of semi-human deities, typifying the worst as well as the noblest passions—how men made their gods "like unto themselves," until the instinct of reverence was blunted, and the downward course ended in gross materialism. But this would be digression, and we must keep our direct course.

PTOLEMY.—We now follow the Sun from theology into history, and find the Greeks engaged in constructing a science of the universe. Even yet remained a trace of the older faith, in Pythagoras' defence of the central position of the Sun—that fire was the diviner element. He made the Earth revolve about the Sun, and Nicetas revolved the Earth upon an axis to explain the apparent motion of the heavenly bodies; but the weakness of the logic clouded the truth of the theory, and it was treated as a dream. The common sense of mankind demands that new theories shall be reasonable, whether true or false; so when Hipparchus and Ptolemy appealed to the senses for evidence of the central position of the Earth, and accounted for the rebellious variations in the motion of Sun and Moon by an

eccentric position of the Earth in their orbits, the *vox populi*, like our Rev. John Jasper, shouted: "That is the philosophy for us; we can see the truth of it with our own eyes." So the Ptolemaic system ruled the world through ages well named "dark," until the great revival of the intellect approached, which swept away the clouds that darkened every phase of human life.

Worshipped for ages as a god, degraded for thirteen centuries into an appendage of his own petty satellite, little cared the Sun for either. Shining alike on the just and unjust, on friend and foe, as though he knew his own value and theirs, he did his work, regardless of others' smile or frown. There is a moral lesson here for those who can receive it.

COPERNICUS.—In the middle of the fifteenth century, a new light breaks upon the world. Copernicus, rejecting the system of Ptolemy after thirty years of vain struggle to reconcile it with existing facts, challenges tradition by restoring the Sun to his rightful place. The so-called philosophers, entrenched in their conservatism, laugh him to scorn. Another half century passes, Tycho, meanwhile, enriching knowledge with his observations. Then Kepler, treading in the footsteps of Copernicus, discovers the elliptical form of the planetary orbits, the law of equal areas in equal times, and the relation of the squares of their times to the cubes of their distances. And Galileo, after defeating the Aristotelians and proving the law of falling bodies at the famous leaning tower, turns Jansen's telescope upon the heavens, revealing the moons of Jupiter, the phases of Venus, the various phenomena of the Moon and the spots on the Sun. Every observation confirms the newly-discovered laws—a new science is born. Well may Kepler exclaim: "The book is written, to be read now or by posterity, I care not which; it may well wait a century for a reader, since God has waited six thousand years for an observer."

NEWTON.—The history of these men is a lesson for all coming time. Beside the enormous difficulties inherent in their work, they had to encounter the scorn of schools founded on the traditions of centuries, the frowns of a social order that feared the growth of mind, and the persecution of a church that found its safety in the ignorance of its devotees. All this they endured for the sake of the truth; and the truth grandly vindicated itself and immortalized them. The Sun settled upon his rightful throne, his subject worlds moving in orderly succession about him; one thing more was needed to complete the basis of the new science—the law by which he ruled his kingdon—the force which kept the planets in their orbits; and for this, too, the man was ready. Newton, standing on the vantage-ground won by his predecessors, proclaimed the law: "Every particle of matter attracts every other, with a force proportionate to the quantity of matter in each, decreasing as the square of the distance increases." From this generalization he started in search of the curves that bodies governed by it must describe, expecting to find the ellipse, already found to be the form of the planetary orbits, but the search resulted in the mathematical expression including all the conic sections—thus accounting not only for the motion of the planets, but the circular orbits of the moons of Jupiter, and the curves described by those erratic members of the solar family, the Comets.

The value of these discoveries cannot be overestimated. The problem of the ages was resolved. Simplicity, order and beauty replaced the complexity and cumbrous machinery of the old systems. The era of true physical astronomy had begun. "Old things had passed away, and all things had become new." This brief review of the early history of the science is given, first, because it should have a place in a course intended to cover the solar system, and second, because its results contribute directly to all the operations by which we reach the facts of solar physics. From this point, investigation proceeded by new methods, whose history we need not follow, being chiefly concerned in their results. Of the innumerable questions asked concerning the Sun, we will give attention to those which have been answered by facts or well-sustained theories.

DISTANCE.—The first estimate of the Earth's distance from the Sun was one hundred millions of miles, afterwards reduced to ninety-five millions, and still later to ninety-two millions—the last approximation, averaging the results of several observers, being given as ninety-two and one-third millions of miles. It is easy enough to say this and to write it down, but how shall we realize the meaning of the figures? A railway train at a continuous speed of thirty miles an hour would take 350 years to reach the Sun. We know how suddenly we remove our fingers from red-hot iron here; yet if the youngest of you could stretch his arm over the whole distance and touch the glowing surface of the Sun, where the same iron is heated into vapor, sensation travelling at the rate given by the best authorities, would not inform the brain of the injury done to the fingers for one hundred and thirty years, and by that time you would scarcely think it worth while to draw them back! We think the electric telegraph takes no time at all to act, and it does work quickly, 20,000 miles in a second; but it would take your dispatch an hour and a quarter to reach the Sun. All illustrations fail to give any adequate idea of the real value of such figures; these have been chosen as some of the most striking. [The method of finding the Sun's parallax and determining his distance was demonstrated here, for which see the diagrams of any good text-book.]

SIZE.—Having settled the question of distance, the size presents less difficulty. The method used upon the Moon can be applied to the Sun on a larger scale. When the Moon at her node comes between the Sun and the Earth, we have a total eclipse of the Sun, and the Moon just covers the glowing disk. We know the diameter of the Moon and the distances of both bodies; divide the distance of the Moon into that of the Sun, multiply the quotient by the Moon's diameter, and you have an approximation to the diameter of the Sun. The diameter is thus found to be over 850,000 miles, which would require a row of over a hundred Earths like ours placed end to end to reach across it. The volume of the Sun is a million and a quarter times that of the Earth; it would serve no useful purpose to give it in cubic miles, as the figures are already too large to convey any adequate idea of their meaning. Suppose that within the glowing visible surface was a hollow sphere, and through a convenient spot we could drop our earth; it would have the proportion of a three-inch ball in a twenty-six foot globe; the Moon might keep her present distance of 240,000 miles, and revolve in her orbit more than 180,000 miles within that vast circumference. Now take the other planets—Vulcan, if you can find him, little Mercury, Venus, Mars and his insignificant moons, great Jupiter, equal to 1,400 Earths, Saturn 760, with their moons and rings, Uranus and Neptune with their satellites, and drop them in after the Earth—then the Asteroids, to fill up the interstices between their superiors—catch the Comets, if you choose, and put them in, though when reduced to average density they occupy so little room as to be hardly worth the trouble—and when you have exhausted the system, you will have filled but a six-hundredth part of the Sun's enormous volume.

WEIGHT.—To weigh a body of such dimensions seems a heavy contract. Fairbanks does not make scales on a sufficiently large scale, and if we had them where should we set them? We fall back upon the law of gravitation. Bodies attract each other in proportion to mass, and inversely as the square of the distance. We find the distance per hour that the Moon is drawn out of a straight line by the attraction of the Sun. In this way we find that the Earth draws the Moon nearly eleven miles an hour, and the Sun draws the Earth about twenty-four miles an hour. [Illustrated by diagram.] The law of the square of the distance will tell us how far the Earth would draw the Moon if it were placed at the distance of the Sun; and this distance would bear the same proportion to the distance the Earth is drawn by the Sun, as the weight of the Earth does to the weight of the Sun. By this means we find that the Sun's attraction, and therefore his mass, is over 350,000 times as great as the Earth's. It is no part of my work to show you how the Earth is weighed; but it

is weighed, and by it we find the weight of the Sun to be 2,154,106,580,000,000,000,000,000,000 tons. The effect of this enormous mass upon a body at his surface is to make it weigh twenty-seven times as much as here. If one of our young lady members, weighing say 100 pounds, should visit the Sun, of course accompanied by a young gentleman, she would weigh 2,700 pounds—over a ton and a quarter—and would lean on his arm with a weight of half a ton; while he could not lift his own feet from the hot surface. The Sun would not be a good place for dancing!

DENSITY.—Having both the size and mass of a body, its density is a matter of simple division. Assuming the Earth's density as unity, we find that of the Sun to be about one-fourth. His bulk is equal to more than 1,250,000 Earths, the mass is about 350,000; therefore the density is about one and four-tenths that of water—less than that of the smaller planets, and greater than that of the larger ones.

LIGHT.—From the Sun, across the 92,000,000 miles of distance, come to us countless rays of *something*, of whose nature we know very little; but without its influence we should know nothing about anything. Upon it depends all we have and all we are, physically. In those solar rays are bound together, in an inexplicable union, influences to which we give the names of Light, Heat, Color, Chemical Action. Think what those four terms mean to us! Color—the blue of the sky, the green of the fields, the beauty of the spring flower and the autumn leaf, the glory of the sunset. Heat and chemical action—the germination of the seed, the growth of plants, the shade of trees, the perfume of the gardens, the ripening of the grain. Light—which makes all visible, and calls all the other forces into action, if indeed it does not prove to include them all. All these are bound up in every solar ray. We reap its benefits even when we are turned away from the Sun. The plants grow in the dark, by part of the heat absorbed by the Earth in the day; and in the fibres of the trees more is stored away in buried forests, to be exhumed and liberated for the coming generations. The air we breathe is circulated and freed from the poisons that are the product of stagnation, by the action of the solar rays; which rays, again, lift into the air millions of tons of water every day, to be distributed to every quarter of the thirsty land, and returned again to the sea, stopping on the way to drive the wheels of the mills that grind our grain, and furnish the steam for a thousand industries of man. And the day is coming when the solar heat shall serve us even more directly. At the Paris Exposition stood a strange machine, pointing sunward the axis of an immense funnel-shaped reflector, gathering the rays to a linear focus upon the boiler of a working engine, and realizing one-horse power to ten feet of surface. So we shall find here a resource when the woods are wasted and the coal beds exhausted.

What we owe to the solar ray may be summed up in a few words: First, the preparation of the world for human life, then that life itself, then the air and food by which it is sustained, and the surroundings which make it enjoyable. And yet how small a fraction of his influence do we receive. Suppose a sphere constructed about the Sun as a centre, at the distance of the Earth; the portion of its surface occupied by our planet would be but one two-billion,-three-hundred-millionth (1-2,-300,000,000)—and that proportion and no more of the light radiated from the Sun. Our Monument Square in Lancaster is 200 feet each way, giving a surface of 5,760,000 square inches; the fraction of an inch obtained by dividing 5 760,000 by 2,300,000,000 represents the proportion of light the earth receives. But you say, "The Sun has other worlds to provide for." True enough, but when we have measured them all and made the proper allowance, one hundred times our fraction is found to cover them all, and the whole quantity of light intercepted by all the members of the system remains but 1-230,000,000 of the whole. The rest of it—almost all—is radiated into space, for what purpose we cannot tell—but the evidence of Divine economy apparent in this world forbids the supposition that it is wasted.

SOURCE OF POWER.—We know, of course, that all this enormous expenditure involves proportionate loss. How is the supply kept up? The only source of heat we know is combustion; one of our most combustible substances is carbon; yet if the Sun's mass, vast as it is, were pure carbon, he would be utterly consumed in 5,000 years. If he were simply glowing with inherent heat, the present radiation would in the same period cool him so as to be unfit to serve us as a Sun. And yet we know from the testimony of the Earth's crust that this radiation has already lasted for a hundred million years. How is it maintained? The answer sounds strangely to the unaccustomed ear. The Sun's heat is kept up partly by the falling of bodies upon his surface, but chiefly by the contraction of his own mass shrinking inward into narrower limits, caused by gradual cooling of the matter composing it.

Innumerable meteors fall constantly from all parts of the system into the Sun, drawn by his irresistible attraction from enormous distances, and traveling with enormous speed. This velocity is apparent to us from the fact that when they pass through our atmosphere its slight resistance causes them to glow with heat, though composed of solid substances, as is shown by the composition of those which are intercepted by the Earth. You remember the one exhibited at the Centennial, the recollection of which makes one feel like taking a walk every time he sees a shooting star coming in his direction. The velocity of these bodies reaches 300 miles a second, and striking the Sun at that speed, ten thousand times as much heat is generated as by the combustion of an equal mass of pure carbon. I suppose it is unnecessary to go into the correlation of forces to prove that arrested motion is converted into heat; school-boys know it by painful experience, and their teachers by contemporaneous observation. It is claimed that meteors enough might thus have fallen to keep up the supply of heat, without appreciably increasing the Sun's bulk since first accurately measured. If, however, we were dependent solely on the meteoric supply, present conditions would be of limited duration; all the meteors would be gathered in.

But the other source of heat is practically illimitable. In the past the solar contraction was far greater in amount, but less in effect; for it is plain that the farther he contracts, the greater heat evolved by every inch of further shrinkage. Here we meet what seems a serious difficulty. It has been calculated that the shrinkage from infinite space to the Sun's present dimensions would have furnished heat for only twenty million years instead of the hundred millions required by the Earth's crust. This objection disappears if we adopt the theory that the central nucleus of the Sun is very dense as compared with the surface you see—that the real mass occupies a space as small compared to what we see, as the visible part is to the real Sun. Many facts point to this theory as the true one; and accepting it, we have the best explanation of the supply of heat thus far proposed, and need have no apprehensions of the failure of solar heat for an indefinite period in the future.

SUN SPOTS.—The physical constitution and conditions of the Sun are our next subject of inquiry. The ancient theory made the Sun a mass of fire, or intensely hot matter, with a uniformly luminous surface. Galileo's telescope detected spots upon the surface, and from his time until our own these spots have been observed. We do not know with certainty; it is with them as with our neighbors—we may know a great deal about them, yet not know *them*. So with the spots on the Sun. We have watched them, seen their action, discovered something of the laws that govern them, but we cannot be said to know *them*. What do we know *about* them? First, they prove the rotation of the Sun upon his axis; appearing at one side, passing over and disappearing on the other, and reappearing as before. It must not be supposed that they are permanent or preserve the same size and shape while they last. They rarely last for many rotations, and their changes of form and size are so rapid and of so great extent as to be almost inexplicable. Nearly all the spots are found in two zones, on either side of the equator.

The spot is usually composed of a dark nucleus, with shaded edges. When we say dark, the term is used relatively; one writer says that the darkest portions of the spots are as light as 2,000 full moons; but in this connection we must also remember that the calcium light, whose dazzling brilliancy you all know, when projected upon the Sun, is quite black. These spots are often of great size; the largest observed was 185,000 miles in length—more than twenty-three times the Earth's diameter—quite large enough for our abandoned packing process. Some of these spots assume a spiral form, indicating a cyclonic disturbance in the luminous matter, in which it is often difficult to determine whether the action of the force is upward or downward, though sometimes immense quantities of matter are apparently thrown out with a tremendous explosive force. Sometimes a spot presents several nuclei, separated by portions of lighter color; again two or more spots unite to form one. The number of these spots increases and diminishes in periods of a little over eleven years. It would seem probable that these spots are openings in the luminous covering or photosphere, from the fact that their change of form during rotation corresponds to what it would be in that case.

The period of the spots already noted, as well as other apparently periodic variations at shorter intervals, has been attributed to the motions of the planets, but careful observation discredits the hypothesis. Magnetic disturbances coincident with spot-phenomena have also been observed, but the connection is not yet demonstrated. Near some of these spots, as they approach the edge of the disk, certain very bright streaks are frequently seen, which are the most brilliant part of the Sun. Sometimes the edge of a spot presents what has been called a "willow leaf" appearance. These are the principal appearances connected with the spots. We shall see that they furnish argument for the assumed existence of a dense nuclear mass within the photosphere. While this lecture was in preparation, a friend called my attention to a newspaper statement that a Babylonian tablet had been deciphered, which recorded observations of the spots on the Sun. This antedates Galileo by some thousands of years, and taken in connection with the lens found at Nineveh, by Layard, indicates the existence of an older science of astronomy.

THE PHOTOSPHERE.—The luminious surface which we see is called the photosphere. Of what does it consist? We do not know. We shall find in the atmosphere the vapor of certain substances, known to condense into liquids at very high temperatures, and a hypothesis has been proposed that this luminous envelope may be a stratum of such condensed vapors. The spots would then be accounted for by the cooling of the photosphere, produced by downward currents from the upper regions of the atmosphere. These currents would have the greater velocity of the upper regions, and would increase the velocity of the lower stratum, thus accounting also for the proper motion of the spots, which should be greatest at the equator, as is the fact. The whole surface of the photosphere, seen through the telescope, appears coarsely mottled—divided into oblong forms by rows of dots or pores, seemingly interstices between the luminous forms, which have been compared to "rice grains," probably on account of their size, which sometimes reaches 1,000 miles long by 500 wide! It is clear that an enormous quantity of matter must occupy the space between the outer limit of the photosphere and the nuclear mass—enormous absolutely, though relatively small. Some of its elements we know; their condition is indicated by the degree of heat required to vaporize iron, for iron vapor we know is there. This matter, at least in the spot region, is in tremendous commotion; the roaring of cyclones thousands of miles in extent, explosions of frightful violence, occurring somewhere on the surface every moment, must make up a volume of sound inconceivable and utterly intolerable to mortal ears!

THE ATMOSPHERE.—But in the visible Sun, vast as we know him to be, we have seen but a fraction of his true volume. Outside the photosphere is a complex atmosphere, three or four hundred miles in depth—too shallow to be seen by the best telescopes—whose existence was demonstrated by the spectroscope at the total eclipse of 1870, and has been verified since; and in this atmosphere exist the vapors of iron, copper, lead, nickel, cobalt, sodium, magnesium, and other elements, including hydrogen. Oxygen and nitrogen are indicated by experiments of Dr. Draper, but cannot yet be said to be demonstrated, though the *a priori* probability of their presence is so strong that we may feel certain of it in advance of the proof. These vapors are present in the Sun's atmosphere, as the vapor of water is in ours, in varying quantity; glowing hydrogen is a constituent element there, as oxygen and nitrogen are here. From this atmosphere, very possibly condensation may cause these vapors to be precipitated npon the Sun in showers of metallic rain; and beneath the photosphere may ebb and flow metallic oceans on the surface of the nuclear Sun!

SPECTRUM ANALYSIS.—"But," says some incredulous listener, "how do you know that these substances are there?" By means of the *Spectroscope*. You take a three-cornered piece of glass, hold it so that a ray of light admitted to a dark room may pass through it; it breaks the bond that held the elements together, and you have upon the opposite wall the solar spectrum. To the eye, it seems a brilliant series of the rainbow colors, shading so gradually into one another that not a tint seems missing—as though millions of finest threads of different tints had been placed side by side, with infinitely fine gradation. But the spectroscope reveals that thousands of these threads are absent from the solar spectrum, leaving dark lines in their vacant places. It was discovered, too, that every element, when in the form of glowing vapor, emits rays of a tint peculiar to itself, and also has the power of absorbing rays of the same tint which it emits. The rays from a glowing mass being passed through our vapor, if the vapor be cooler than that mass, it cannot make up by emission for the rays it absorbs, and these are missing from the spectrum; if it be hotter, it more than makes up the loss, and those lines are brighter; if the temperatures are the same, the spectrum is unchanged. So it is clear that every missing line in the solar spectrum represents absorption by some vapor in the Sun's atmosphere; and if we can identify the line or lines peculiar to a known element in a given condition, we have evidence of the existence in that atmosphere of that element in that condition. This has been done, and thus we have proven the existence of the elements named, and some others, in the atmosphere of the Sun.

HYDROGEN ENVELOPE.—Outside this atmosphere we find an envelope of glowing hydrogen, extending to a depth varying from five to six thousand miles, into which, from time to time, other vapors are, or seem to be, poured from the Sun's interior, especially in the neighborhood of great spots. These eruptions sometimes extend to an enormous height, forming the objects known as prominences. It is not certain that these vapors are thus poured from beneath; it may be a change of condition of vapor already present, just arriving at a glowing condition. The spectroscope seems to indicate movements of tremendous velocity toward and from the observer, which favors the eruptive theory. These colored prominences extend to a height of a hundred thousand miles. One of them was seen apparently torn into shreds by a tremendous explosion, one fragment being forced upward to an altitude of 200,000 miles.

THE CORONA.—But we have not yet reached the outermost envelope. During total eclipses a halo surrounds the hidden disk like that which encircles the heads of the pictured saints. This is called the *Corona*, and is composed of matter which reflects the solar light. So great is its heat that Edison's heat-measuring instrument, the tasimeter, showed that we received from it an appreciable quantity during total eclipse. In 1869 the spectroscope proved that part of its light came from a glowing gas, but Jansen demonstrated, in 1871, that its light was chiefly reflected sunlight. It has been suggested that the light is reflected from streams of meteors which are known to exist in great numbers in the region

immediately surrounding the Sun; but this theory has not been verified. Sometimes from this envelope long streamers are thrown out to a distance of millions of miles. Up to the eclipse of last July, the outer corona had been traced to a distance of a million miles from the Sun; but on that occasion Newcomb traced it to ten million miles, and Abbe followed the streams to a height of five million miles.

ZODIACAL LIGHT.—In 1870, Proctor expressed the opinion that the zodiacal light, which all of you have seen in the spring and fall, in the western sky after sunset, was simply an extension of the solar corona. It had been traced to within a distance of 8,000,000 miles of the Sun, extending thence to 80,000 000, but the corona had then been traced to only 1,000,000 miles from the Sun, and the theory was considered extravagant. The results of last July, as we have seen, bridged over the gap, and demonstrated the connection; so we have in the corona and its extension, the zodiacal light, the outermost envelope of the Sun thus far discovered.

We thought the Sun visible to our eye was a large body; what shall we say now? The figure of the zodiacal light is that of a flattened spheroid like the Earth's, only far more flattened; its long diameter is 160,000,000 miles, and its axial diameter about 20,000,000; and this enormous volume has been shown to be part of the true body of the Sun. But though the volume of this disk exceeds that of the visible Sun more than eight hundred thousand times, his mass exceeds that of the disk in a still greater degree. Perhaps this flattened spheroid is the result of the Sun's attempt to throw off another ring, and so increase the planetary family.

ROTATION ON AXIS.—We have seen that the Sun is in motion, rotating on its axis, which is proven by the apparent motion of the spots. And here we meet with one of the most wonderful facts connected with the subject. While the equatorial belt makes its revolution in twenty-five days, the polar regions require twenty-eight days. It is almost impossible to imagine the conditions which could produce this combination, except by regarding the photosphere as a gaseous envelope surrounding the solid nucleus, which of course would revolve uniformly. We learn also from this rotation that the axis of the Sun is inclined to the plane of the ecliptic at an angle of 82° 45′—seven and a-half degrees from the perpendicular. This is proven by the observed fact that at two periods in the year the spots describe straight lines across the disk, while for half the remaining time they describe curves convex to the Sun's upper limb, and the other half convex toward his lower limb.

THE SUN A STAR.—Such is the Sun, as related to us. We have endeavored to compress the facts, so far as known, into the briefest compass, and have resisted the temptation to speculation, not even mentioning many theories held by men of note, because they have not been verified. Yet how vast is the Sun, in the light even of these figures: and how small by comparison seems all else within our knowledge—*except the stars*. For the Sun is but *one* of these, perhaps one of the least, certainly not one of the greatest. Even on the boundaries of his own system, on frigid Neptune his apparent dimensions have shrunk to those of a star; light diminishes as the square of the distance increases; yet the Sun holds the planet in his place by the strange power of attraction, acting over that great distance in less than a second, though it takes light four hours to cross it. Even beyond the sphere of his attraction his light carries into space the record of his existence; and the astronomer at Alpha Centauri, our nearest neighbor, may to-night be placing him upon his catalogue, "21 Cephei, variable;" for the spot periods would, of course, cause variations in his brilliancy and consequently in his magnitude at great distances.

IS THE SUN INHABITED?—In conclusion, I ask your indulgence for a very few moments to be devoted to speculation. Is the Sun inhabited? Do intelligent beings exist upon it, with organs adapted to their surrounding conditions? It has been well said by another, in reference to our own satellite, that it does not follow because we could not exist there, the Divine resources were exhausted in our creation, and, therefore, no inhabitants exist on the other heavenly bodies. For myself, I reject that supposition entirely and at once. In the world with which I am best acquainted, I see everywhere most marvelous adaptation and economy; the forms of matter and of life, nature and man are exactly fitted for each other; equilibrium is the law. Man consumes oxygen and rejects carbon; the plant consumes the carbon, and rejects the oxygen; and so throughout the physical world. All things are made for each other, and furnish food for the intelligent mind; and the mind is here to use them. I believe the rule holds good throughout the universe, in our Sun and all the suns and their planets. Wherever matter exists, intelligent creatures exist with it. God has no waste matter.

How slight the change needed to justify the hypothesis—a mere modification of external organs would fit beings like ourselves for life at the Sun. Eyes that could bear the intensity of the light, ears that would not be deafened by the roar of the molten elements, tissues that could resist the intense heat—given these, our minds would be as much at home in the new body as in the old, and we could enjoy the study of astronomy from a solar standpoint And we may not need material organs. We are taught that we are spirits clothed in material forms; what matters the form to the spirit? Herschel believed the Sun to be inhabited; Dr. Dick thought it an impertinent presumption for man to assume the contrary.

Whether the theory be true or not, we shall never know in this stage of life. But perhaps after awhile, when that sense of immortality which seems inherent in mankind shall find its realization in the freedom of the spirit from the limitations of earthly bondage—perhaps *then* we shall be endowed with eyes that can see the whole spectrum, the heat rays at one end and the chemical rays at the other, demonstrating that unity of light and heat which seems now dawning upon us—with ears that can hear the deep tones produced by the rolling of the worlds through space—the spiritual body being superior to material conditions: then, traveling with the speed of thought, we may visit the Sun, learn from the kindred intelligences who inhabit it the secrets of his power, witness the play of stupendous forces within and below the blazing photosphere, and at length, having mastered the science of the Sun, start thence upon a pilgrimage through the illimitable universe.

## THE MOON.

BY WM. F. DUNCAN.

PREMISING only that we do not aim at strictly scientific accuracy, we shall present briefly some reflections on the Moon, that bright, resplendent orb, the "Queen of Night." The subject of the earliest investigation of astronomers, she is no less interesting to us now than in those early days when she was an object of wonder and often of worship. Although among the smallest of the heavenly bodies, her nearness to the Earth, the variety and beauty of her changes, her relation to important physical phenomena, and her immense value as a factor in astronomical investigations, all combine to render her an object of profound interest. As she rolls in nightly splendor through the sky all that is grand and sublime in nature receives from her magic pencil a newer charm.

POPULAR NOTIONS.—Before entering upon the historical and scientific aspects of our subject, we shall notice a few popular ideas that have long been current in regard to the Moon. For instance, the influence of the Moon upon vegetation has been long known, and advantage taken of it in practical agriculture for many years! Few of the older inhabitants of our county do not know, from the testimony of others at least, that if the Moon is on the increase those vegetables must be planted which fructify above ground, as corn, peas, grain, etc. Cucumbers, pumpkins, etc., increase at full

Moon, while, if she be on the wane, those which develop underground must be chosen, as potatoes, beets, turnips, etc. Onions are much larger and better nourished during the decline of the Moon than at her increase, and during her youth; for which reason it is said the Egyptians abstained from onions, on account of their antipathy to the Moon. It is also generally understood that in one position of the crescent the rain falls in floods; in another, drought ensues; while in the intermediate position the showers are properly distributed! Hence the universal desire, amounting to anxious expectancy, which keeps many of our rural friends on the *qui vive* to get the first glimpse of the new Moon and apply its predictions!

There is also a rule of general application in which we city dwellers are equally interested, namely, that if you can see the new Moon for the first time over the right shoulder, your pocket-book will have the same proportions, plethoric or otherwise, at the next new Moon as at the present. It is only necessary, therefore, to have a full-pocket-book at a single new Moon and to look for her over the proper shoulder to insure easy circumstances for life!

The Moon has also a singular effect upon the minds of some classes of people. This is so fully recognized that it has left its mark on language, and "lunatic" and "lunacy" are the words, par excellence, to express the ideas they represent. This belief is not entirely an illusion, and must not be confounded with some of those just mentioned. Somnambulists have their peculiar condition strongly excited by the Moon's light and at the full Moon; and the condition of many insane persons is aggravated at particular lunar periods. So much for popular beliefs concerning our satellite; let us now proceed to a consideration of the facts.

CONSIDERATION OF FACTS.—Among the first things that must have been noticed by the earliest observers of the Moon, exciting their wonder and curiosity and challenging their investigation, were the changes that take place nightly in her appearance and position in the heavens. Let us note these changes, or phases, as they are termed. Commencing our observations at the time of new Moon, we see her early in the evening in the west, a little after sunset, a slender, silvery crescent, her convex side towards the Sun, the horns pointing to the east; a few evenings later, at the same hour, we find her not only much farther east but greatly enlarged in size; again a few evenings, still at the same hour, and we see her appearing in full-orbed radiance above the eastern horizon. While the stars have risen and set with but little variation, the Moon has risen on an average about forty minutes later every evening, and has advanced eastward during the twenty-four hours about thirteen degrees.

In about fifteen days from the time when it is first first seen in the west, it will be seen directly in the east, rising about the time the Sun is setting. When it is in this position it is said to be in opposition to the Sun. Should we continue to observe it, we will now find that the illuminated part of its disk gradually diminishes until it again assumes a crescent shape. But now its horns point towards the west, whereas when we first saw it they pointed towards the east. It now rises a little before the Sun, and can only be seen early in the morning, its crescent growing smaller and smaller until at last it disappears.

After being invisible for a few days, we again see it as a crescent in the west, when it goes through the same course of changes as before, with unvarying regularity. This, doubtless, it has done ever since it was first placed in the firmament by the Creator as "the lesser light to rule the night."

The time consumed in making these changes, measured by our day, is a little more than twenty-nine and a-half days, which period is termed the synodical or lunar month, and is reckoned from the time of one conjunction to the next. The Moon, however, makes one complete revolution in its orbit in a little more than twenty-seven days, which is called the sidereal month, and is reckoned from the time she leaves a fixed star until she again reaches the same point. The difference in time between the lunar and sidereal months is caused by the Earth's motion in her orbit, and amounts to about two days. If the Earth were at rest, the synodical and sidereal months would be of the same length, for the Moon in passing from conjunction would reach conjunction again exactly at the completion of one revolution. But while the Moon is revolving around the Earth, the Earth has advanced in her orbit in the same direction, and the Moon must pass over as many degrees as the Earth has advanced before she can come again into the same position with respect to the Sun and the Earth.

From these phases we learn that the Moon is a satellite to the Earth; that, like the Earth, she receives her light from the Sun; for when we see the Moon at her full, with her disk fully illuminated, it is because we are between the Sun and the Moon, and the entire side that the Sun lights up is turned towards us. At the time of new Moon, she is between us and the Sun, and we cannot see the side that is illuminated. When the Moon is at her first quarter we make a right angle with the Sun and Moon and can see only one-half of the illuminated side.

DISTANCE.—The Moon is the nearest to us of all the heavenly bodies, being in round numbers distant about 240,000 miles; this distance is a mere trifle when compared with other celestial distances. If a body could fall from the Moon to the Earth it would arrive here in about three days. To go from here to the Moon would take rather more time; if we could go by steam we might get there in about a year. In measuring the distance to the Moon, the Earth's diameter has been used as a measuring rod, and the calculations are made on the same principles as those by which surveyors measure distances on the surface of the Earth. It would be very inconvenient if, in measuring long distances, they should have to go over the ground and measure it foot by foot or rod by rod; so by a method known to them, termed triangulation, they ascertain the proportion between these distances and other spaces which have previously been accurately measured. In this way it has been ascertained that the Moon's distance from the Earth is about thirty times the Earth's diameter, which, being about 8,000 miles, makes the Moon's distance as stated.

It is, no doubt, owing to this comparatively insignificant distance that the Moon has been supposed to exercise so great an influence over mundane affairs. An old writer say that "not only intelligent and animated beings, but all terrestrial nature, including vegetables and minerals, are under its rule," of which several instances have already been given.

SIZE.—Having thus learned the distance, it is a comparatively easy matter to ascertain the size. We know that an object at some distance away from us seems smaller than when it is nearer to us, and that if we increase the distance it apparently diminishes in size. For instance, the ball on Trinity Church steeple, Lancaster, as we look at it from the ground, seems to be a few inches in diameter, but we know that its real diameter is about three feet. So when we look at the Sun and the Moon in the heavens, they seem to be about equal in size, but it is only because the Sun is farther distant than the Moon. We know this also from the fact that there are times when the Moon gets directly between us and the Sun, while the Sun never gets between us and the Moon.

Now, if we take an object whose size we know, as a small ball, say one inch in diameter, and hold it between our eye and the Moon, at a short distance from the eye, it will entirely conceal the Moon from sight, and will indeed appear a good deal larger than the Moon; in fact you will have a total eclipse of that body. If you should suspend this ball in a line between your eye and the Moon, and then gradually increase your distance from the ball, you will find that at a certain point your ball will exactly cover the disk of the Moon, and be apparently of the same size, neither more nor less. Increase your distance still more and your ball will now appear a little smaller than the Moon, and the bright ring of the latter will appear all around the cir-

cumference of your ball and you will have something resembling an annular eclipse. If now you measure the distance from the eye to where the ball exactly covers the Moon, you will find it to be about ten feet, or 120 inches; or, what is the same, 240 half-inches.

We have already ascertained that the Moon's distance is 240,000 miles; our ball's distance is 240 half-inches, so that 1,000 miles in the Moon's distance is just equal to one-half inch in the ball's distance; and under the conditions described, the ball and the Moon are apparently of equal magnitude. We may, in fact, regard the ball as another Moon on a smaller scale, and if we know the scale we can use the ball to measure the Moon's size and distance, just as we use the scale upon a map. In this case the scale is one-half inch to 1,000 miles, and, as we know that the ball measures two half-inches in diameter, the Moon must measure twice 1,000 miles, or 2,000 miles in diameter. And this is very near the correct size as given in the books, but to avoid perplexing figures we give round numbers. This very interesting experiment any of you can try for yourselves, using any other object whose size you know as a scale.

The Moon, then, is a globe, whose diameter is about one-fourth that of the Earth. Her surface is estimated at about one-thirteenth, her bulk about one-fiftieth, her weight a little less than one-fiftieth, and her density about one-half that of the Earth.

ROTATION ON AXIS.—It has been noticed that the Moon always turns the same side towards the Earth; if we observe her at different times we always see the same relative arrangement of light and shade; and the most remarkable objects, such as the mountains and valleys, are always seen in the same positions. The explanation of this singular phenomenon is that the Moon rotates on her axis in about the same time that she performs her revolution around the Earth. It has been suggested that the Moon's centre of gravity does not coincide with the centre of her mass, and that she is consequently heavier on one side than on the other; also, that it is the heavier side that is turned towards us. Should this be so, and the Moon rotate on her axis with anything like the velocity of the Earth, she would be likely to "wobble" considerably.

From observations that have been made, it has been noticed that the apparent size of the Moon's disk is not always the same, at one time appearing larger and at another time smaller. This can be caused only by change of distance, as before explained, and shows that the Moon is nearer to the Earth at one time than at another, which could not be the case if her orbit were circular. From careful observations the figure of her orbit has been ascertained to be an ellipse, with the Earth in one of the foci, and with a greater deviation from a circle than the orbit of the Earth. When she is nearest to the Earth she is said to be in perigee, and, when most remote, in apogee. The variation in distance is about 26,000 miles.

MOTION IN ORBIT.—Although we call the Moon's orbit an ellipse, it is so only as respects the Earth. In reality it is an irregular curve, *always concave to the Sun*, and crossing the Earth's path every thirteen degrees, nearly. Before looking into this matter, I always supposed that the Moon revolved around the Earth in a regular curve, retracing its path, as it were, again and again; but after studying the subject somewhat, this was found to be a mistaken impression. The Moon never retraces her path, but, attached to the Earth by ties that cannot for a moment be broken, she is constantly carried forward by that body on her annual journey around the Sun. At conjunction she is inside the Earth's orbit; at her first quarter she crosses the path of the Earth 240,000 miles behind her; she now rushes along in her path with tremendous speed, the impulse of the Earth's motion being added to her own and thus constantly gaining on the Earth, passes it in seven days as full Moon. Continuing her impetuous course, and all the time gaining upon the Earth, she crosses its orbit 240,000 miles ahead. She is now inside the Earth's orbit, and from this point the Earth gains on the Moon, and in seven days overtakes her as new Moon. The Earth still continues to gain till, in seven days more, the Moon crosses her orbit 240,000 miles behind the Earth, as she did four weeks before. Thus the Moon winds her way along being sometimes inside and sometimes outside the Earth's orbit, always gaining when outside and falling behind when inside this orbit. The path she describes around the Sun, and Earth, is an epicycloidal curve, cutting the Earth's orbit twice every month, and everywhere concave towards the Sun.

Now, if the Moon's path around the Earth were in the same plane as the Earth's path around the Sun, at each new and full Moon the three bodies would be exactly in a line with each other, and we would have two eclipses every month, one of the Sun and one of the Moon. But this does not happen, and for a very simple reason. The Moon's path is inclined to the Earth's at an angle of five degrees, so that when she reaches the point where she would enter the Earth's shadow she is sometimes above and sometimes below the shadow. An eclipse of the Moon can take place only when she is at the full, for only then is the Earth between the Sun and Moon. She must also be at or near one of her nodes, or points where her path intersects the plane of the ecliptic.

The average length of the Earth's shadow is more than three times the Moon's distance from the Earth, so that the Moon cannot fail to get into it occasionally. The Earth being smaller than the Sun, and spherical in form, the figure of the Earth's shadow is that of a cone, projected into space, and varying in length and breadth with the varying distance of the Earth from the Sun. Eclipses return nearly in the same order in about eighteen years. This has been called the Metonic Cycle, and the Chinese used it more than three thousand years ago to predict their eclipses.

When an eclipse of the Moon occurs it has been noticed that her disk is illuminated by a reddish light This is caused by the refraction of the solar rays. As they enter our atmosphere they are bent into the shadow, and passing onward strike the Moon and thence are reflected to us, rendering her surface, even in shadow, distinctly visible. The first eclipse of which we have any record occurred nearly 2,600 years ago, on the 18th of March, 720 B. C., and was total at Babylon.

The Moon's axis is not exactly perpendicular to the plane of her orbit, but inclines about one and a-half degrees; this, in connection with the fact that her motion in her orbit is variable while that on her axis is uniform, occasions certain phenomena called libration—the Moon appearing to roll a little on her axis, first one way and then the other. When this rolling motion is east and west, it is called her libration in longitude, and enables us to see a little more of her eastern and western edges; when it is north and south it is called libration in latitude, and we can see a little more of her poles.

We cannot stop to explain in detail the many uses made of the Moon in astronomical science. We have but alluded to her value as a factor in that respect. Mitchell sums them up thus; "So intimate is the relation between the Earth and her satellite that scarcely a question can be asked with reference to the one, that is not answered by the other. If we demand the weight of the Earth compared with the Sun, the Moon answers. If the excess of her equatorial over her polar diameter, the Moon answers. If the homogeneity of of the interior of the Earth, the Moon replies. If the thickness of the Earth's crust is sought, question the Moon and the answer comes. If you would know the Sun's distance from the Earth, ask the Moon. If the permanency of the axis of rotation be in question, the Moon alone gives a satisfactory reply. If we inquire whether the length of day and night be uniform, or have changed by so much as a single second in a thousand years, in every instance her replies to these profound and mysterious questions are clear and satisfactory."

PHYSICAL ASPECTS.—In conclusion, let us refer briefly to the specnlations relative to the Moon's physical condition. Is it, as many hold, an extinguished star, dead and cold, uninhabited and uninhabitable serving no other purpose than to furnish light to the

Earth? What are the facts, so far as known? When we look at the full Moon with the naked eye, we see that she is not of uniform brightness. Some parts appear less bright than others. Looked at through a good telescope she presents a wonderful and imposing sight. The darker spots resolve themselves into valleys or extensive plains; the brighter spots into lofty mountains projecting their shadows far into the plains below. There are rings of mountains, surrounding wide plains, from the centre of which often shoots up a lofty peak; we can not only look on them, but into some of them, for they are hollow from top to bottom. One of the finest of these ring mountains with its inclosed crater is the spot called Tycho. This mountain is about 12,000 feet high; its crater is fifty miles wide, and its depth 17,000 feet, the bottom of the crater being about 5,000 feet below the surface of the plain.

All over the disk of the Moon are scattered singularly formed cavities, some of them as much as forty miles wide and four miles deep. Her surface indeed presents a scene of wild confusion and terrific ruggedness, differing vastly in this respect from our own planet. More than a thousand of her mountains have been measured and many of them named, such as Newton, Tycho, Copernicus, etc., and it is a curious fact that her surface was known before that of our Earth, and her mountains measured before the same thing was done for our own. One of these craters, named Linne, was, in 1866, the locality of an observed phenomenon which seems to confirm the opinion of Herschel, given in 1787, that active volcanoes still exist on the lunar surface. In October and November of the former year Linne was obscured by "a whitish, luminous cloud," which disappeared in September and left the crater distinctly visible again. The omission of this crater from the maps of Schroetter and the globes of Russell, made in 1797, lead to the inference that it had been previously obscured. The latest observations indicate that the old crater has been partly filled up by an eruption from below. The volcanoes of the Moon, active or extinct, probably had the same origin as those on the Earth, proving that both planets must once have been blazing stars.

It is evident from the absence of shading off from the illuminated part of the disk that there is little or no atmosphere on the Moon, and as there are no clouds there can be no water. Hence it follows that the Moon is uninhabitable by beings like ourselves. But it does not follow that it may not be inhabited by intelligent creatures with organs adapted to their circumstances. To draw such an inference would be to question that Divine wisdom, so admirably displayed in the construction of our own world and its inhabitants.

VIEW FROM THE MOON.—Assuming, therefore, that the Moon is inhabited, we will close with a glance at our Earth from the Moon. What a magnificent point from which to observe the heavens! As there is no atmosphere, there is no sky. Space is a black abyss. As there is no water, there is no vapor, and no cloudy canopy ever obscures the starry heavens. In the daytime as in the night, are seen stars, planets, comets, shining points set in intense blackness. The Sun passes among them without extinguishing their light. Around us eternal silence reigns; no sound is ever heard; no gentle breeze is ever felt; no rushing tempest ever awakens the echoes of this strange world. No rain ever falls; no sunset or twilight tints are ever seen; all things are either black or white, according as they are in the light or shadow. As we see only one side of the Moon, it follows that only one side of this body sees us. So that those who live on the hemisphere turned from us—if any do live there—must journey into the other hemisphere, some of them as far as 1 500 miles, in order to see their Moon, our Earth. And what a magnificent spectacle the Earth must present to the Lunarians, through their long night of fifteen times twenty-four hours duration. Fixed forever in their sky, appearing to them fourteen times larger than their globe does to us, and shining with extraordinary splendor, she revolves on her axis every twenty-four hours showing them her continents, seas, and islands in perpetual panorama. She exhibits to them the same phases that the Moon presents to the Earth. They see her as a silver crescent; slowly she passes on to her first quarter and through her gibbous phase to full Earth; again she becomes gibbous; and again diminishes to a crescent—and now, before she disappears entirely from our view, we hasten back to her more familiar hills and valleys, and bid the Moon "Good-night."

## INTERIOR PLANETS.

BY A. A. HUBLEY.

TWO tiny atoms among heaven's host of shining lights, not specially distinguished in their characteristics above the other works of their Great Architect have been selected for consideration this evening. These wanderers of the sky, pursuing their appointed pathway around the Sun in orbits between that of the Earth and the Sun, have obtained the name of *Interior Planets*, and an examination of some of their varied phenomena and physical characteristics, as supplied by the deductions of a science far reaching beyond even our thoughts, will not prove to be devoid of interest.

Venus and Mercury are said to be *Interior* Planets. What proofs have we that they are such? This fact may be proven in three ways:

1. If they did not revolve in orbits between that of the Earth and the Sun, they would sometimes be seen in *opposition*—occupying a position opposite the Sun, as the Moon does when full; but in fact they are never visible, as are the other planets, rising in the east when the Sun is setting; nor are they ever seen in quadrature or on the meridian when the Sun is either rising or setting, but always his close neighbor, as either Morning or Evening Star.

2. If viewed through a telescope they are seen presenting to us successively all the phases and appearances of the Moon, waxing and waning from the beautiful crescent, when situated directly between the Sun and the Earth, to the full-rounded orb when on the opposite side of their orbit, and in other positions every variety of form between these two extremes—phenomena which can only be accounted for by supposing them to be opaque bodies, shining by the reflected light of the Sun while revolving in orbits smaller than that of the Earth.

3. A phenomenon, peculiar to these two planets, and of particular value from a scientific point of view, is their passing at certain periods over the face of the Sun, producing what is called a *transit*. Such a phenomenon could, of necessity, not be produced by bodies revolving outside the Earth's orbit.

MERCURY.—Mercury, the first in order of distance from the Sun, is a small, brilliant, white body, the smallest, with the exception of the Asteroids, in our system. Owing to the extreme brightness of his disk, his velocity of revolution, and his nearness to the Sun, he is rarely visible except by the aid of a considerable magnifying power. The most favorable times for observation, without such instrumental aid, are in the months of March and April, and in August and September, when his greatest elongations occur in those months. When these periods occur in any other months he is rarely visible. It is said that Copernicus himself, in a whole life devoted to the study of the heavens, never once caught sight of this almost invisible world.

How far back the history of Mercury may be traced cannot be told, but the earliest observations upon its appearance recorded (taking Brocklesby as authority) were made on the 15th of November, 265 B. C. He also says that in the year 118 A. D., on a certain day, Chinese astronomers located it in a certain position in the heavens, which position, by backward calculation, modern astronomy has proven to have been correct to within less than one degree. This statement, if correct, would indicate no mean advancement in the science of astronomy in those days.

Its diameter of nearly 3,000 miles does not indicate a very imposing size; our own little planet is equal to

twenty globes of that size. Its motion in its orbit round the Sun is from west to east, uniform in direction with the motion of all the other planets, occupying a period of nearly eighty-eight days, making its year equal to about three of our months. The velocity of its motion is greater than that of any other planet yet discovered, reaching 105,000 miles an hour as compared with the Earth's 65,000. Its distance from the Sun varies greatly, ranging from 29,000,000 miles when at perihelion distance to 44,00,000 when at aphelion.

Its period of rotation on its axis was for a long time left in doubt. Not until the time of Schroeter, an eminent German astronomer, in the latter part of the last century, was any evidence that could be considered decisive, obtained. His observations demonstrated the existence of spots, which his assertions lead us to believe are mountains of immense size, situated in its southern hemisphere and rising to the extraordinary height of ten miles or more. By carefully noting the motion of these spots, and the daily position of the horns of its crescent, he determined the period of its rotation, and therefore the length of its day, to be a little more than twenty-four hours, about ten minutes longer than our day. The inclination of the plane of its orbit to the ecliptic is about 7°.

The force of gravity upon its surface is not known with any certainty. The only way left to determine this point is to observe the effect produced on the orbit of any comet that, in its erratic course, may pass near Mercury, and even this is not satisfactory in result, from the uncertainty as to precisely *how much* of that disturbance is due to its attraction. Heretofore its density has been set down as equal to a body of lead of the same size, but later investigations have reduced this estimate very decidedly, placing it but one-sixth greater than that of the Earth. As the weight of an object is only another name for the measure of the attractive force, using a spring balance, a pound weight, earth measure, would lose more than half its gravity, if taken to Mercury, and would weigh only seven ounces.

What an appearance the Sun must present viewed from Mercury! Our eyes ache at the thought of the intolerable brilliancy of a disk seven or eight times greater than what we see; and yet, while glorious, it must be a terrible phenomenon, with an intensity of light and heat that, if not tempered by some peculiarity of organization in the planet and its surroundings, must render it totally unfit as a habitation for creatures whose physical being bears any close resemblance to our own.

Whether the same succession of seasons exists as on the Earth cannot be told with any certainty, but whatever they are, they move on with rapid strides, its year being only one-fourth as long, and the seasons of corresponding length.

Transits of Mercury, or its apparent passage over the Sun's disk, occur with sufficient frequency to take them out of the category of rare phenomena, as are those of Venus. The first one observed was seen by Gassendi, in 1631; the last occurred on May 6, 1878, with a total number to this time of 33, while three more are predicted for the remaining years of this century.

VENUS.—Venus the second planet in order of distance from the Sun, lying in an orbit between those of Mercury and the Earth, the brightest body in our firmament with the exception of the Sun and the Moon, is readily distinguished from all the other planets. Her remarkable brilliancy, the regularity with which she ushers in the evening twilight or heralds the coming dawn, a spectacle of beauty whenever visible, the constancy with which, at all seasons of the year, she may be found in attendance upon the Sun, combine to make her an object of marked attention and interest.

As she is known to recede to a greater angular distance from the Sun than Mercury, her orbit of revolution must, of necessity, be the larger of the two. We therefore find her occupying a position between Mercury and the Earth at a mean distance from the Sun of sixty-six millions of miles, and in an orbit that is nearly a circle, with the Sun a little out of the centre. The variation in her perihelion and aphelion distances being only 900,000 miles. When she passes directly between the Earth and the Sun she is said to be in inferior conjunction; when at a point directly opposite the Earth, on the other side of the Sun, in superior conjunction.

In her pathway through her orbit there are certain periods when she appears to retrogade or move backward, and become stationery. First visible close to the horizon after sunset, each evening apparently falling behind the Sun, and remaining a few minutes later, in the course of a few months we find the distance separating her from the Sun to be about 47°, or about halfway between the horizon and the zenith. This is her greatest elongation; beyond this she cannot move; and gradually retracing her course, setting a few minutes earlier each evening, she finally approaches the Sun, and is swallowed up in his beams. An interval of eight or ten days then elapses, and we find her hovering on the horizon of the eastern sky, in the early dawn, rising with the Sun as the Morning Star. Gradually increasing her distance, she makes her appearance a little earlier each day until she again attains her greatest angular distance, when she returns by slow degrees and is again lost to view. Once more she appears as Evening Star. And thus her course of changes moves on unceasingly. As her greatest angular distance from the Sun cannot exceed 47°, and the apparent movement of the heavens, caused by the diurnal motion of the Earth, is equal to 15° an hour, she can be visible only for about three hours after sunset, and the same length of time before sunrise—completing the whole circuit in 224 days, nearly seven and a-half of our months, at a velocity of 77,000 miles an hour. This is called her *sidereal* revolution.

Her period of rotation on her axis, as observed by Cassini, a French astronomer, as early as 1666, was determined to be somewhat over 23 hours. Later observations threw some doubt upon this result, until Schroeter, by observing the daily positions of her horns and the movement of certain spots (the same means he used in determining the rotation of Mercury), obtained the same period as Cassini, within one minute. This period can therefore be stated with certainty to be 23 hours and 21 minutes, or about 35 minutes less than that of the Earth, with an equal length of day.

Her diameter is 7660 miles, but her apparent size and brightness as seen from the Earth are not uniform. At her nearest point to the Earth she is only 26,000,000 miles distant; at her farthest, 158,000,000. With such a variation in distance, it might be supposed that her brighest aspect would be presented when she is nearest to us. But just at that time the side turned toward the Earth is left in shadow, and is therefore invisible. Passing her nearest point, a very small portion of her enlightened surface is turned towards us, showing a very narrow, delicate crescent. As she continues to move forward, receding from the Earth, all the appearances which we are accustomed to associate with the phases of the Moon are successively exhibited, until she reaches her gibbous phase, near her superior conjunction. At that point, if she could be seen, she would appear perfectly round like the full Moon, but it has been generally asserted by astronomers that she is invisible then, as she is completely concealed by the Sun's rays. Using Dick as authority, it may be said that her limit of visibility is one and one-half degrees from that point. In her passage from superior conjunction, she again develops all her phases, but in a reverse order, to her inferior conjunction where the crescent again makes its appearance to inaugurate another succession of changes. About a month before and after this period, although but a small part of her bright surface is visible, the planet presents her brightest appearance.

At certain intervals, about every eight years, when she is also nearest overhead, from the southern declination of the Sun, this brilliancy is increased to an extraordinary degree, so much so as to render her visible at midday, as was the case last year. It is said that she has then been known to cast a shadow.

From her inferior to her superior conjunction, for the space of 292 days, she is visible to us on the west side of the Sun as Morning Star; for the same length of time

from superior to inferior conjunction she appears on the east side of the Sun as Evening Star. Now it may appear somewhat singular that while the whole period of her revolution is only 224 days, she can remain in each of these alternate appearances for 292 days. But the Earth has a motion in its orbit by which it passes round the Sun in 365 days, while Venus, moving in a very much smaller orbit, and with greater velocity, is able to cover her revolution in about two-fifths of that time; so that when the Earth has completed its round, Venus has done the same, and passed considerably beyond the point where both planets would be in a line with the Sun. So it has been found that 584 days is the time of her *synodical* revolution, or her relative movement with respect to the Earth. Now, if both these bodies moved in the same plane, every 584 days or nineteen months, we should be able to see Venus projected as a round dark body on the face of the Sun. But the orbit of Venus being tilted 3½° is sufficient, as the angular diameter of the Sun is only thirty-two minutes, to cause it to pass a little above or below the Sun's disk, except at certain rare periods.

It is evident that there must be two points where the orbits intersect each other; these are called the *nodes* of the orbits. The nodes in the case of Venus fall in the months of December and June, and it is only in those months that her transits are possible, and only then when there is a conjunction of the planet, its node, and the Sun. Such a condition can occur only when a certain number of complete revolutions of Venus are exactly or very nearly equal to a proportionate number of the Earth's revolutions. Such a proportion exists nearly between eight revolutions of the Earth of 365 days each, and thirteen of Venus, of 224 days each, or more exactly between 235 of the Earth and 382 of Venus. Take, for example, the last transit on December 8, 1874. Thirteen revolutions of Venus will, in the time required, make eight revolutions of the Earth or eight years, causing her to occupy very nearly the same position she did at that date, and a transit at the December node will therefore occur in 1882. If there was perfect equality between these eight revolutions of the Earth and the thirteen of Venus, then this phenomenon would occur with perfect regularity at intervals of eight years. But while the inequality between these proportions is not sufficient to prevent a transit in a single period of eight years, yet with the lapse of time it is continually increasing, doubling itself in sixteen years, trebling in twenty-four years, etc., until finally it is equal to a whole revolution of Venus, in 235 years, when the same relative positions are again attained, and another transit will occur. Although we will not be living to witness it, we can reckon upon the occurrence of another transit of the December node in A. D. 2116. They also occur at the same intervals of eight and two hundred and thirty-five years at the June node; we therefore have a recurrence of these rare phenomena only at intervals of an average of eight and one hundred and thirteen years.

The transit of A. D. 1769 was observed by expeditions fitted out by England, France, Denmark, Sweden, and Russia. This, among other purposes, was the object of the English expedition under charge of Captain Cook, whose station was among the islands of the Pacific Ocean, where he afterwards met his untimely fate, with the account of which we are all familiar. At the next transit, which occurred in 1874, millions of dollars were expended by all the civilized nations of the world, and hundreds of skilled astronomers, stationed at over 70 points, widely scattered over the Earth's surface, turned their instruments towards the Sun. And now, it may be asked, What is the value of these observations, and what results are gained?

A transit of Venus furnishes an immense measuring rod, by which the distance of the Earth from the Sun being determined accurately, the whole solar system, its distances and extent, are laid open to view, as on a map. Kepler first predicted the occurrence of a transit, and its application to the solution of the Sun's distance. That transit was invisible in Europe, the Sun having set. The next transit, occurring in 1639, was observed by a young English clergyman, Jeremiah Horrox, but his results were erroneous, placing the distance at about 60,000,000 miles. Halley, A. D. 1672, proposed the method now bearing his name, to be used by the astronomers living at the time of the next transit. The succeeding one, only eight years later, was also observed by this and other methods, and the angular distance (8.57) as obtained then, was used in all the text books up to the last quarter of a century. Other methods for computing this angle, in use in these later times, seemed to throw a shade of doubt upon its exactness, and it was to determine the amount of this possible error, and settle the distance definitely that the transit of 1874 was looked forward to so eagerly; the results so far as calculated were given in a previous lecture; but even greater preparations will be made for the transit of 1882.

To Venus the Sun will present a surface twice as large as we see it. The brightest body in her nocturnal sky will be the Earth, when in opposition to the Sun, shining with a splendor five or six times as great as Jupiter, with a brilliancy sufficient to cast a shadow, as our Moon does when a crescent. Our Moon also will be visible with a magnitude equal to Jupiter, showing all her phenomena, eclipses, transits across the Earth's disk, etc.

Notwithstanding the wide range of conjecture concerning the seasons, etc., based on the assumed inclination of her axis it is very probable that the characteristics approximate so nearly those of the Earth as to make the analogy between climate, surface, atmosphere and habitability equally close.

Cassini, in 1672, ventured the assertion that Venus is attended by a satellite, at the time of observation presenting a phase similar to her own, and about one-fourth her size. In 1686 another observation gave the same result. In 1740, Mr. Short, with a magnifying power of 240, noticed the same body, with the same characteristics—its light not very bright, and clear and sharply defined. The same appearance was witnessed by a number of other astronomers, and on the strength of these observations, its time of revolution, distance, inclination and other elements were computed; its magnitude was equal to that of our Moon, and the phases it assumed were always those of its primary. It is difficult to reconcile all these circumstantial statements with the fact, that, in these later times, with improved means of observation and equally skillful observers, no such body has been detected, and while it is not impossible that such a body can exist, the facts so far seem against it, and the verdict can only be "not proven," leaving it to future investigations to demonstrate the truth.

VULCAN.—The existence of an intra-Mercurial planet or planets has, until very recently, been left in the same state of uncertainty as that of the last mentioned body. While there was nothing improbable in the supposition, the doubt that hung over it could not be dispelled. That region of our system was assumed to be full of small meteoric bodies, but whether of sufficient size to be visible was the point to be determined. Leverrier, the noted French mathematician and astronomer, in writing up the elements of Mercury, observed certain perturbations which could not be accounted for by any disturbing power with which he was familiar, and pointed to the probability that either a planet or a group of planetoids occupied an orbit sufficiently near to exercise an influence over his motions. The total solar eclipse of 1869 finally furnished an opportunity of settling the vexed question. "Maps of all the stars in the region of the Sun were carefully studied—sections of the sky about the Sun were assigned to different observers who should attend to nothing but look for a possible planet." The latest authority consulted, in a work published this year, concedes that this long-sought-for planet, has at length been brought to light by Professor Watson, of Ann Arbor, Michigan. Vulcan is his name, the God of Fire; his symbol, the hammer; distance from the Sun, 13,000,000 miles; revolution in his orbit, twenty days.

Whether the reported existence of this Vulcan, like that of his namesake, shall prove to be mythical or not, at all events, he is the latest contribution to our knowledge of the *Interior Planets*.

# EXTERIOR PLANETS.

A. S. HERSHEY, ESQ.

THE Exterior Planets are so called because they revolve round the Sun in orbits *exterior* to that of the Earth. They are sometimes called superior planets for the same reason. At present the heavens present a fine opportunity for the study of these brilliant orbs. In the early part of the evening three most prominent of the superior planets may now be seen following each other through the heavens, with Jupiter in the lead, Saturn with his rings close upon him, while burning Mars brings up the rear. What a grand opportunity for the astronomer! If he tires of Jupiter and his moons, that are ever changing in position, with their transits across the disk of the planet and their constantly recurring eclipses, he can direct his instrument to Saturn with his rings and satellites, or view the landscapes of Mars.

MARS.—Mars was named after one of the ancient deities who was the god of war. No doubt the astronomer gave the planet this name from its ruddy appearance. The Jews gave it the name of "blazing," from its red color. Mars does not always appear to us of the same size; at conjunction it is much smaller than when in opposition, which is owing to the difference in the planet's distance from us. When at the point nearest to us in its orbit its diameter is more than seven times greater than when at its most distant point.

It revolves around the Sun at a mean distance of 140,000,000 miles. This orbit, like those of all the planets, as Kepler has demonstrated, is in the form of an ellipse, and in consequence the planet is nearer the Sun in some parts of its orbit than in others. The orbit of Mars is flattened out considerably, and it has been estimated that its perihelion distance is twenty-six million miles nearer the Sun than its aphelion distance. The Earth's orbit varies only three million miles, thus making the variation of the orbit of Mars about nine times as great as that of the Earth. Mars was the planet npon which Kepler decided to make his observations on the motion and orbits of the planets. Finally, after experimenting and watching the planet for seventeen long years, he announced his grand discovery, the three great laws of motion.

Mars sweeps around the Sun in its orbit with an average velocity of fifteen miles per second, which is three miles less per second than the rate at which we, upon the Earth, are hurried through space. It makes a revolution on its axis in 24 hours and 40 minutes. This makes the Martial day but forty minutes longer than our own, and since its year contains 668 days, this would be equal to 687 terrestial days, or nearly two of our years.

The diameter of Mars is about 5,000 miles, and the circumference 15,708 miles. The volume of Mars has been estimated to be one-fourth that of the Earth, its density only one-half; hence its mass or weight is only one-eighth as great as that of the Earth, or 758 quintillions of tons.

The light and heat of the Sun at this planet is less than one-fourth that which we enjoy, being twice our distance from the Sun. It axis is inclined 28.70° to the plane of its orbit; therefore its seasons cannot differ very much from ours, as the Earth's axis is inclined 23½ degrees. Its days are nearly equal to ours, but there must be a greater change in the length of night and day in the different seasons of the year, owing to its greater angle of inclination. The seasons of Mars must be about twice as long as ours, because the year is equal to two terrestial years. Shadows or dark bodies are often seen passing over its surface. These are supposed to be clouds in its atmosphere.

Until quite recently Mars was supposed to be without moons, but in August, 1877, Prof. Asaph Hall, of the Naval Observatory at Washington, discovered two satellites revolving around the planet; the outer one at a distance of about 12,000 miles, making its revolution in thirty hours and eighteen minutes, traveling almost as rapidly as the planet on its axis, so that when once in sight, to an inhabitant on the planet, it could be seen for a long time before it sets. The other is but 3,600 miles from the surface of the planet. This is only a few hundred miles farther than the distance from New York to San Francisco. There is one peculiarity about this satellite. As it passes round the planet in 7 hours and 40 minutes, it will be seen that it travels faster than Mars rotates on its axis, and in its course overtakes an object on the planet, and since it travels in the same direction, it passes by the object and sinks out of sight in the east, rising again in the west. This rapid motion of the moon causes also, to the inhabitants of Mars, an apparent motion of two moons in opposite directions.

As we look at Mars in the heavens he appears to us only as a red star; but under the telescope he presents a novel appearance, and astronomers claim that they have discovered land and water, and also, "ice-caps" at the poles, which are supposed, like our own polar regions, to be covered with perpetual snow. These spots grow larger and become smaller, decreasing with the return of summer and increasing with the return of winter. [Illustrated by maps and diagrams.]

We all know that there is three times as much water as land surface on our globe; on Mars this order is reversed and there is *three times as much land as water.* Prof. Proctor says the older a planet grows the less water will be visible upon its surface; that it passes into the body of the planet; and as proof of this he cites Mercury and Venus, which are supposed to have very little water.

Mars, like the Earth, is not a perfect sphere, but is somewhat flattened at the poles, caused no doubt by its rapid revolution on its axis, which tends to bulge it out along the line of the equator. It has slight phases, which proves that the planet like the Earth is an opaque body, and shines with borrowed light.

JUPITER.—Passing outward from the Sun, the next planet in our course is Jupiter, named after the king of the gods. Jupiter is the largest planet of the solar system. He can easily be distinguished from the other planets and the fixed stars around, from his great brilliancy. This was one of the earliest discovered planets and was credited by the ancients with extraordinary power and influence in mundane affairs.

The average distance of Jupiter from the Sun is 475,000,000 miles. The orbit of this planet has much less eccentricity than those of the planets nearer the Sun—a wise provision of nature, because if his orbit were less circular, the influence of the Sun would be insufficient to hold him in it. If we look at Jupiter we find that he changes his place but little with reference to the fixed stars. We observe that other planets move over the surface of the heavens, overtake Jupiter and pass him by, while he apparently moves slowly along. Yet he goes at the rate of 500 miles a minute—or from Philadelphia to Pittsburgh and back again in little more than a minute; his year is equal to twelve of our years, and he therefore passes through one sign of the Zodiac during each of our years. While he moves slowly in his orbit, on his axis he revolves very rapidly, completing a revolution in ten hours, any object on his equator revolving with a velocity of 467 miles per minute as compared with the Earth's equatorial velocity of seventeen miles per minute. This produces a powerful centrifugal force, which must greatly diminish the weight of a body on the surface near the equator.

The diameter of Jupiter is about 88,000 miles, or one-tenth that of the Sun. Its volume is one thousand four hundred times that of the Earth, and much greater than that of all the other planets put together. If he should take the place of the Moon in the heavens, he would appear to us one thousand two hundred times as large as our full Moon, giving us light enough to dispense with gas during full Moon. His density is only one-fourth that of the Earth. The equatorial diameter exceeds the polar diameter by about 5,000 miles, which is equal to the diameter of Mars. This is caused by his rapid motion on his axis, which must have continued since the creation of the planet. As the inclination of the axis of Jupiter is slight, it follows that the days and nights are of almost equal length throughout the year—five hours from sunrise to sunset. With so little in

clination of the axis there can be but little change of seasons; there must be perpetual summer at the equator, continuous spring in the temperate zones, and winter reigns supreme in the polar regions.

The heat and light of Jupiter are only one-twenty-seventh of that which we receive; so that unless there is some other means, unknown to us, compensating for the loss of heat and light, it would not be a very inviting place of residence for man. But if the Jovian citizen does not enjoy our bright and genial sunshine he can boast of a magnificent night. In five hours he can see all the constellations that pass over our heads during the night, besides witnessing four moons with their divers phases in different parts of the heavens. These moons were first discovered by Galileo in the year 1610, through the telescope, although there are instances on record where they have been seen with the naked eye. They revolve at the following distances from Jupiter: No. 1—270,000 miles; No. 2—425,000 miles; No. 3—678,000 miles, and No. 4—1,200,000 miles. The diameter of the smallest is 2,100 miles, and of the largest 3,500 miles. [Illustration by diagram, showing the eclipses, occultations and transits of the moons.] They must revolve with great rapidity to overcome the attraction of Jupiter, otherwise they would be drawn in to the planet. The nearest moon goes through all its phases in one and three-fourth days, and the most distant in less than twenty days. If Jupiter is inhabited, its citizens can witness during a Jovian year 4,500 lunar eclipses and about the same number of solar eclipses.

VELOCITY OF LIGHT DISCOVERED.

This is a fact well worth mentioning in connection with the moons of Jupiter. It was observed that the eclipses of Jupiter's satellites, which occurred while the Earth and planet were at their least distance from each other, always came on sooner than the time predicted by the tables; while, on the contrary, those which took place when the planets were most remote from each other occurred later than the computed time. Rœmer, a Danish astronomer, finally solved the problem. He found that these irregularities arise from the fact that light moves through space with a finite and measurable velocity. When Jupiter and the Earth are at their least distance from each other, the stream of light flowing from the satellite of the planet traverses a shorter space to reach the eye of the observer on the Earth by nearly 200,000,000 miles than when the planets are more remote from each other. In case this stream of light is in any way cut off, it will fail sooner in the first than in the second position, by the time required to pass over the diameter of the Earth's orbit. The stream of light is actually shorter by nearly 200,000,000 miles in the first than in the second position. Now, the satellites of Jupiter receive their light from the Sun; they reflect this light to the Earth; and when Jupiter is interposed between them and their source of light, they are eclipsed—their light is cut off. And when the stream of light starting from them, at the instant the supply is cut off, shall have run out, or failed, then and not till then does the satellite become invisible. By this means light was found to travel the entire diameter of the Earth's orbit or 185,000,000 milles in about 16 minutes, giving a velocity of nearly 12,000,000 per minute.

The telescope reveals to the observer a number of belts upon the surface of Jupiter of different colors, constantly varying in size, but all seeming to take a parallel course across the equatorial regions. The dark belts are supposed by some to be large masses of clouds, and the bright belts are mere fissures, laying bare the surface below: and the parallel appearance of the belts is supposed to be caused by equatorial winds, similar to our trade winds. Some two years ago a large red spot was noticed on Jupiter, which has been gradually increasing in size. [Position and size indicated in diagram.]

SATURN.—Leaving Jupiter and continuing our outward course, we next reach Saturn, the most distant world known to the ancients, and in many respects the most remarkable planet of the solar system. It has not only double the number of satellites of Jupiter, but has, in addition, a number of rings encircling it, some shining with a golden light and others being transparent. This planet performs its revolution around the Sun in 29½ years, at a mean distance of 872,000,000 miles, in an orbit considerably flattened.

The diameter of Saturn is about 68,650 miles, or about nine times that of the Earth, and it would require 760 globes like the Earth to make a bulk equal to Saturn. It moves through space at the rate of 21,000 miles per hour, and yet, as we look at it night after night, we can scarcely detect any change of place. The Saturnian year comprises about 2,500 Saturnian days, and is equal to nearly thirty of our years.

In 1793, Sir William Herschel saw a quintuple belt, and by frequent examination of this belt he found Saturn's rotation a little over ten hours, making Saturn's day about ten hours. He also noticed that the polar regions change their appearance as they are turned towards or from the Sun, which, as in Mars, might be owing to snow at the poles. Saturn has eight moons, all varying in size and distance from their primary, and their eclipses and occultations are somewhat similar to those of Jupiter.

Galileo first noticed something peculiar in the shape of Saturn. Through his imperfect telescope, it seemed as though several smaller planets had nestled close to each side of old Saturn, and he first thought Saturn was threefold; but as the planet approached the equinoxes, this strange appearance vanished altogether. This perplexed the astronomer very much, and he died before the mystery was solved. The rings, seen again at a later period, were thought to resemble handles attached to the planet, but for what purpose no one conjectured. This appearance was due to a break in the luminous rings made by the projected shadow of the planet. The plane of the rings is inclined twenty-eight degrees to the ecliptic. In its revolution around the Sun, owing to this inclination, the ring is sometimes observed as a broad ellipse, at other times as a straight line, barely discernable with the most powerful telescope. The rings are three in number, about one mile in thickness, and of equal breadth, surrounding the planet at the equator. The exterior ring is separated from the middle ring by a distinct break, while the interior is joined to the middle one. The exterior ring is of a grayish tint, the middle one is the most brilliant, and more luminous than Saturn himself.

Prof. Proctor, in his recent lecture at Fulton Hall, in speaking of Saturn and his rings, said we have in them an illustration of the nebular hypothesis in miniature, and that probably these rings would at some time change into globular form and add three more to the number of satellites of this planet.

URANUS.—Saturn was for a long time supposed to be the most distant of the planets, and it was not until 1781, on the 13th day of March, that Sir William Herschel discovered a new planet and named it after Uranus, the most ancient of the gods. Uranus revolves around the Sun at a mean distance of 1,754,000,000 miles. Its year exceeds eighty-four of our years. Its diameter is about 33,000 miles, and it is more than sixty times as large as that of our Earth. This planet has four satellites, which differ in their motion from the other members of our system in this respect that, instead of revolving around the planet from west to east, the order is reversed and they move from *east to west*. Another peculiarity about these moons is, that their orbits are inclined almost at right angles with that of the planet's orbit.

NEPTUNE.—We now come to the last and most distant planet of the solar system—Neptune, the god of the sea. Astronomers, in observing Uranus, noticed slight perturbations, and came to the conclusion that there must be a planet beyond Uranus that had some influence upon him. Mr. Adams, of England, and Leverrier, of France, calculated the position of the planet, which result was announced to the Academy of Science, at Paris, in the summer of 1846. The discovery of this planet, by means of mathematical computation, was the grandest triumph of mathematical science in the history of the world. Very little is known of the planet, but it has been ascertained that it revolves around the

Sun in a period of 164 years, at a distance of about three billions of miles. Its diameter is given as 39,000 miles, and its bulk 120 times that of the Earth. No spots can be detected on its disk, and therefore we know nothing about its time of rotation, or the inclination of its axis. One satellite has been discovered, and, like the moons of Uranus, it has a retrograde motion.

ASTEROIDS.—Planets have another division, besides that into interior and exterior, known as Major and Minor planets, the latter being sometimes called Asteroids. Bode's law would make the distance of any planet from the Sun about double that of the next interior, and half that of the first exterior one. But this law seemed to fail, leaving a chasm between Mars and Jupiter, which was therefore supposed for many years to contain a planet, and which finally proved to be occupied by a very large number of planetoids. Piazzi discovered the small planet Ceres on Jan. 1, 1801, the first night of the present century. This discovery was soon followed by others, until the number is now about 200. Leverrier thinks it possible that there are over 150,000 in all. These planets are all very small, Pallas being the largest, with a diameter of 600 miles, while some could be covered over with a country village. They all revolve around the Sun in regular orbits comprising a zone of 100,000,000 miles in width. Their orbits are variously inclined to the ecliptic; Massilius is inclined only 41 minutes, while the inclination of Pallas is 34°.

The true theory of these bodies is unknown, and a great many astronomers have speculated as to their origin. One theory is that at some remote period a planet here revolved around the Sun, which by some great force was rent asunder and its fragments hurled into space. This may account for the great angle of inclination of Pallas to the ecliptic. The explosion may have forced it far out of the angle of inclination of the planet of which it formed a part. Another theory is that of the nebular hypothesis, that nebulous matter revolved in the orbits of the minor planets for ages, and that it gradually formed itself into these small bodies, and that these bodies will eventually group themselves together and form a large planet like the others of the Solar System.

## COMETS AND METEORS.

BY W. W. GRIEST.

OF all the members of the Solar System, the most eccentric, the most awe-inspiring, the grandest to the physical eye of man, is the Comet. Its signification is "hairy," from the Greek "Coma," and it is so called by reason of its appearance when speeding along beneath the blue concave. The typical Comet consists of a head and tail, the former including a nucleus and envelope. The nucleus is the solid portion, the envelope the nebulous matter without, and the tail the appendage which follows in the wake. However, there are frequently Comets minus one or more of these parts. Sometimes there is no nucleus, sometimes no coma, or envelope, sometimes no tail, though a Comet may have half-a-dozen tails, as that of 1744. But the head, including nucleus and envelope, and the tail constitute the usual "make up" of the Comet, and our next inquiry is concerning the physical nature of these members.

The unsolved problems in relation to these erratic bodies are very numerous, but no one of them is more difficult than to tell of what they consist. Absurdities of all kinds have been advanced in regard to them. Aristotle thought they were exhalations formed of the land and sea; some denied that the reality existed and affirmed that we saw only false appearances caused by the reflection and refraction of light; others have affirmed that Comets were electric phenomena; but the generally accepted theory of to-day is that they are composed of gas, and are a kind of nebulæ. As to the Comets without nuclei the authorities seem to agree that such exist; if the nucleus is transparent—and Montaigne claims to have seen a star of the seventh magnitude through one of them—it must be of similar composition; but if it is true, as recorded, that the nucleus has, at times, eclipsed various stars and partially eclipsed the Sun itself, then it must be opaque, possibly solid, and its component parts are not so certain. The gaseous theory of the constitution of Comets is, however, almost verified by the phenomena attending their approach to the Sun. As they near that luminary, a wonderful change is wrought. The closer they approach it the faster they travel, the more light they emit, the longer the tail, and the greater the violence of their action. Great jets of gas spring towards the Sun and are hurled back almost instantaneously. This phenomenon of attraction and repulsion is the basis of the electric theory referred to above.

Thus a tail, consisting of the products of combustion, repulsed by the power of solar heat, is formed. With but a few exceptions it extends in a direction opposite to the Sun, whether the Comet is approaching or receding. Further confirmation of the gaseous theory is that in 1858, when Donati's Comet visited our system, Arcturus was distinctly visible through the tail which was 90,000 miles in diameter, and as the tail is the waste of the head caused by near approach to the Sun the head must be composed of material much more sensitive to solar heat than planetary matter; for when millions of miles beyond our orbit the Comet begins to illuminate the sky and project its fiery train. Something very capable of vaporization must compose these bodies, and that something, so far as science can discern, is not certainly this, nor surely that, but probably gas.

Where do they come from? Perhaps they were thrown from this and other suns, as were our planets, according to the Nebular Hypothesis. Perhaps, as Mitchell suggests, between this system and other systems, is cometary and meteoric matter composing vast regions of nebula in a state of equilibrium; finally the attraction of this or that sun becomes too powerful, the equilibrium is destroyed, a fragment is torn off, and, in obedience to the eternal law of gravitation, goes speeding towards the sun which most powerfully attracted it. This theory would explain all the phenomena of Comets, including what is otherwise inexplicable—the various directions from which they come—and is in strict accord with the hypothesis of La Place.

The nuclei vary in size from a small asteroid to a mass equal to eight hundred times that of our Earth. The diameter of the nucleus of the Comet of 1811 was 50,000 miles, larger than any of the planets, with the exception of Jupiter, the giant, and Saturn that wears the belt.

The tail is larger than a cat's tail. For the sake of illustration, however, suppose some exceptional cat to have a tail as long as the Comet of 1843. Now were that cat, like many a playful puss, to attempt to find the end of its tail, and maintain its frolicsome disposition throughout its nine traditional lives, allowing nine years to each life, or a period of eighty-one years, it would have to "swing round the circle" at the rate of over 150 miles per hour, for this eighty years and more, before reaching the end of its tail, 112,000,000 miles away! Again, if our feline friend were a healthy animal, and her tail could by some means be nicely curled upon her back, she would walk along without hindrance—her burden of no great weight! Such is the lightness and tenuity of its composition; while the ethereal medium which is affirmed to exist throughout space and which prevents the tail from expanding indefinitely is so light that it passes comprehension. Hydrogen is sixteen times lighter than air, but hydrogen is infinitely heavier than the medium of which we speak.

Sir Isaac Newton calculated that if a cubic inch of air were reduced to the rarity of the atmosphere 4,000 miles miles above the Earth's surface, it would fill a sphere the circumference of which would be equal to the orbit of Neptune. If you were to travel 201 miles per minute you could get around that cubic inch of air in 164 years. No wonder then that the cat could carry its tail; and no wonder Maupertius thought he had discovered the origin of Saturn's belts, when he said that it was the tail of a Comet curled around the planet. But he was ignorant

of the extreme rarity and lightness of this vapor and thought only of the length of the tail. It might have gone around Saturn 437 times and could have circumscribed the Earth 4,480 times!

Comets are at present believed to travel in three kinds of orbits: ellipses, parabolas and hyperbolas. Those in ellipses revolve round the Sun in definite periods; those that move in parabolas and hyperbolas never come back, as the branches of these curves are constantly diverging. After once forming a part of our Solar System they go away, seeking other suns and other systems. The conception of the journey of a parabolic or hyperbolic Comet, through the invisible and inaccessible depths of space, staggers the reason and confounds the imagination. Sun after sun appears and disappears as the lone traveler speeds from "world to luminous world, far as the universe spreads its flaming wall."

To change but not improve on the poet Richter: That Comet which centuries ago blazed in our heavens is now flying past galaxy after galaxy, infinity after infinity. Long since, our Solar System appeared only as a speck against the black empyrean, and all was darkness. Dots of light, as the Comet approached, were transformed into luminous worlds and rushing systems. On it moved, over architraves of eternities, over pillars of immensities, over architecture of galaxies, unspeakable in dimension and duration; past immensities of immensities, eternities of eternities, until, in the dizziness of uncounted galaxies, the possible denizens of the Comet, with the stars, re-echo the answer of the angel: "End is their none to the universe of God!"

Of about two hundred Comets whose orbits have been carefully calculated, one hundred and fifty are ellipses, forty parabolas, and seven hyperbolas, with three doubtful, though possibly ellipses very much elongated.

Previous to the year 1680 nothing was known certainly concerning their paths. On the Comet which appeared that year Sir Isaac Newton made observations, and calculated that it moved in an ellipse, but could not verify his hypothesis. This was a great advance upon the theory of Kepler, two generations before, who held that Comets move in straight lines, and when, in 1682, another of these eccentric bodies was descried, Dr. Halley, a friend and contemporary of Newton's, made a determined assault upon it. He found that there was a wonderful resemblance between it and the Comets of 1456, 1531, and 1607. The times of their appearances were at regular intervals, about seventy-six years apart; their perihelion distances were very similar. Dr. Halley, after taking one thing into consideration with another, made the boldest prediction that the science of Astronomy had ever known. He predicted the return of this Comet in seventy-six years. When the time approached for the re-appearance of Halley's Comet the astronomical world was agog with excitement. In December, 1758, the visitor was seen. The prediction was verified; the path of the Comet was an ellipse; its period was fixed; and the credit of the greatest discovery in the cometary world is due Dr. Edmund Halley. When Halley made the prediction he was twenty-six years old; when it was verified he had been dead sixteen years. This Comet was last seen in 1835 and its next appearance will be in 1911.

Just as the shape of the paths of these bodies differs from that of planets so does the direction of their orbit. They approach to and recede from the Sun in every possible direction. Some come up from the immeasurable depths below, in the language of Young, "having taken their ample round through depths of ether and coasted unnumbered worlds of more than solar glory," and, having "doubled Heaven's mighty cape," again plunge downward on

"The long travel of a thousand years."

Others appear to come down from the zenith, approach with accelerated course, circle our Sun, and reascend into the "dread immensity of space." The universe is full of them, dashing through space at all conceivable angles to the plane of the ecliptic. Millions are said to belong to our solar system alone. Prof. Pierce, of Harvard College, estimates the number at five thousand millions.

To the present time we have accounts of eight hundred Comets. Five hundred have been seen since the Christian era by the naked eye, and two hundred more have been observed with the aid of the telescope. For reports concerning the other hundred, we are indebted, in the main, to Chinese sources.

With this immense number of Comets careering through space is there not some danger that one of them may collide with the Earth and reduce it to a chaotic mass? Professor Newcomb says, "So small is the Earth in comparison with celestial space, that if one were to shut his eyes and fire at random into the air the chance of bringing down a bird would be better than that of a Comet of any kind striking the Earth."

Early in the present century the French Government called a congress of her ablest mathematicians and astronomers to determine, upon mathematical principles, to how many chances of collision the Earth was exposed. Their answer, after careful examination and calculation, was: "Out of 281,000,000 chances only one is unfavorable. Admitting that the Comets which may strike the Earth with their nuclei would annihilate the whole human race, the danger of death to each individual resulting from the appearance of an unknown Comet, would be exactly equal to the risk he would run, if in an urn there was only a single white ball among 281,000,000 balls, and his death were the inevitable consequence of the white ball's being produced on the first drawing."

There is a drop of comfort in that, at least, and still more in the science of to-day which tells us that even were we to come into contact with one of these erratic individuals but little harm would be done. For in 1861 we *did* pass through the tail of a Comet and the only noticeable effect was a peculiar phosphorescent mist. In 1776, a Comet became entangled with the moons of Jupiter. They pursued the even tenor of their way as if the Comet had never existed; while the latter was thrown out of its course, and its orbit changed from a period of one thousand years to twenty years, *i. e.*, from a long to a short-period Comet.

As to the time occupied in moving through their ellipses, Comets are divided into long and short periods. The shortest is Encke's, which completes its circuit in three and one-quarter years. Other short-period Comets are DeVico's, Biela's, Faye's, Brorsen's and Halley's, the latter of which has a period of over seventy-six years. Of long-period Comets, that of 1811, the most wonderful since 1680, will come back in 3,000 years; that of 1858, Donati's, in 2,100; and that of 1844 is expected to return in one hundred centuries.

The velocity of these bodies increases as they approach the Sun, and *vice versa*. The Comet of 1680, the one on which Newton made his observations, traveled at the amazing speed of 1,200,000 miles per hour at its perihelion. It approached nearer the Sun than our Moon is to us, and, according to Newton, must have had a temperature two thousand times that of red-hot iron. As they recede from the Sun into the cold regions of space the velocity decreases and, in the most distant part of their orbits, they creep along at the rate of *a few yards per minute!*

This Comet of 1680, according to Dr. Whitson, the successor of Newton, was the awful prison-house of the damned, which, as it wheeled from the remotest regions of darkness and cold into the very vicinity of the Sun, hurried its wretched tenants by turns to the extremes of perishing cold and of devouring fire. Such crude absurdities were about as numerous as the Comets in the earlier ages, and all looked upon these bodies with fear and trembling. They were regarded by the ignorant—and all were then ignorant of scientific data—as harbingers of war, famine, pestilence and inundations. The great flood, the civil war of Cæsar and Pompey, the assassination of Cæsar, the cruelties of Nero, and the destruction of Jerusalem in the year 70, were all prognosticated by what Pliny called "those fearful stars not easily appeased!"

Halley's Comet has frequently been the cause of

great consternation. In 1456, it appeared in Europe just as the Turks were leading their victorious armies across the Hellespont. The terrified people thought it meant victory to the Mohammedans, and we are told that Pope Calixtus ordered bells to be rung at noon every day and prayers offered for preservation from "the Devil, the Turk, and the Comet." The Comet, possibly not liking the company with which he was thus associated, soon disappeared. Halley's Comet also appeared in 1066, when William the Conqueror invaded England. Of course, that determined the result of the battle of Hastings and the succession to the English crown!

It was universally believed in Germany in 1590, that a Comet caused the epidemic of that year. The sufferer frequently died while in a fit of sneezing. When, therefore, any one heard a sneeze he would bestow his final benediction, "God bless you!" on the unfortunate party. Thus, it is said, originated the habit of exclaiming "God bless you!" when any one sneezes.

These superstitious views have been eradicated from the public mind, and the crude theories of which they bear the imprint, illustrate well the march of science. Two thousand years ago Seneca wrote: "A day will come when the courses of these [comets] will be known and brought under fixed conditions like those of planets." That day has come; but unsolved problems still remain, and cometary physics yet awaits its Alexander.

METEORS.—Meteoric phenomena, the appearance of "evanescent star points" and sudden lights darting through the upper air, are familiar to all. Every one has seen shooting stars, one or more of which nightly flashes and scintillates in divers parts of the sky, and disappears, leaving the darkness more drear in their flight. They speed along at from 35 to 75 miles per second and from 50 to 75 miles above the Earth's surface. The average number large enough to be seen by the naked eye every night in the year is 7,500,000; and if we add the number of telescopic Meteors the aggregate is 400,000,000 daily. So immense and incalculable is their number, varying from the size of a star point to bodies as large as the Moon, that Prof. Pierce has recently published the following: "The heat which the Earth receives from Meteors is the same in amount which it receives from the Sun by radiation, and the Sun receives five-sixths of its heat from the Meteors that fall upon it."

In 1866, May 12th, a star of the second magnitude appeared in the Northern Crown where twenty-four hours before a tenth magnitude star had been. The next day it diminished to the third magnitude, and so on until on the ninth day it resumed its original degree of brilliancy. The theory explaining this, which immediately concerns Meteors, is that the star encountered an enormous stream of meteoric bodies which gave fuel to its flames, and as the fuel became exhausted the star lessened in splendor. On the first of September, 1859, there was a sudden brightening of our Sun, for which the same reason is attributed.

When they are gathered into systems and move through space in a regular orbit Meteors are termed "periodic." Such are the November meteors for which we looked in vain about two months since; and such are the August meteors. The former are encountered every thirty-three years, the latter every year. These two groups are described in the following extract from an article in a recent number of the *Popular Science Monthly*:

"The great November mass is supposed to have existed outside of the Solar System till about 126, when the great planet Uranus, Neptune's brother sentinel on the frontier of the Solar System, arrested this tribe of aimless wanderers through space, and by his tremendous attraction, whirled them into a new orbit, and added them to the subjects of his master, the Sun. We have met it every third of a century since, but the records are very incomplete. It is estimated that it is now about 100,000 miles through, and over 500,000,000 long, so that the head is almost touching the Earth's orbit, while the tail is back between Jupiter and Uranus. Its length is so great that, moving twenty-five or twenty-seven miles a second, it takes two years to pass quite round the Earth and the consequence is that we have two meteoric displays in two successive years, in 1832 in Europe, in 1833 here, in 1866 in Europe, and in 1867 here. The August ring is encountered every year, which induces the opinion that it is complete now, and spreads wholly round its orbit, though it probably started in a lump like the November body. If so, it is an older body than that of November, the latter not having been subjected to the disjoint attraction of the Sun long enough, to be drawn out from a 'lump' into a line. A Comet is traveling at the head of each of these rings."

The radiant point of the November meteors is the constellation Leo; the August meteors the constellation Perseus. Fifty-six such points have been discovered, which is indicative of fifty-six such groups revolving around the Sun. About a dozen November showers have been recorded, the most remarkable being in 1799, 1833, and 1866. That of 1833 was the most brilliant ever known.

The luminous appearance which Meteors present is caused by the friction of the atmosphere. If you attach a thermometer to a driving-wheel going at the rate of 500 feet per second, or over five miles per minute, the mercury will rise sixteen degrees. The Earth travels over 1,000 miles per minute, and plunging into a mass of these bodies which have a like velocity augmented by the Earth's attraction, 600,000 degrees of heat are evolved. The result is light and vaporization. Those that are large enough to reach the Earth before being completely vaporized are called Meteorites, subdivided into Aerolites or Meteoric Stones, Aero-sideroites or Meteoric Iron, and Aero-siderolites, the intervening varieties.

Many instances are recorded where these bodies have reached the Earth, killing men and cattle, and burning buildings. In 1803 a luminous Meteor appeared in Normandy and 2,000 stones, so hot as to burn the hands when touched, fell on an area of 54 square miles. The largest stone weighed 24 pounds. A similar shower fell in 1812, between Vienna and Prague, 200 stones being precipitated in an area eight miles long by four wide. An aerolite weighing 600 pounds, accompanied by 1,000 smaller stones, fell at Kuyahinya, Hungary, on the 9th of June, 1866. One fell in Weston, Massachusetts, in 1807, which weighed 200 pounds, and in 1876 some of the Mississippi Valley States were visited by a Meteor of unusual size and brilliancy. It was first seen in Kansas, at an altitude of sixty miles; in Missouri it began to explode, and continued breaking up while passing over Illinois, Indiana, and Ohio. Terrific explosions were heard throughout its entire path of 1,000 miles. It is said to have been as large as the full Moon.

The composition of these bodies, as a whole, differs from anything terrestrial, yet an analysis reveals no new elements. They consist principally of metallic iron together with oxygen, sulphur, phosphorus, carbon, silicon, nickel, chromium, tin, aluminum, magnesium, calcium, potassium, sodium, cobalt, manganese, copper, titanium, lead, lithium, and strontium.

When we approach the question, What is the origin of these bodies? we tread on uncertain ground. Proctor, in his lecture on the "Poetry of Astronomy," delivered recently in this city, maintained that matter is expelled from the Sun; and that a velocity greater than 380 miles per second is sufficient to carry it away from the Sun's immediate vicinity. Perhaps some Meteors do thus originate. If so, it is in accord with the following, clipped from the *Cornhill Magazine*:

"Each sun and each planet, each asteroid and each moon, has its eruptive stage, in which, diverse though the powers of large and small orbs may be, expulsive power probably has been, is, or will be attained, competent to drive the expelled matter beyond the attractive range of the parent mass. Nor need we be perplexed by the consideration that, in thus viewing millions of meteors and meteorites as Sun-expelled or planet-expelled masses, we seem to set on one side the evidence which shows that the orbs peopling space have been, in large part, formed by the aggregation of meteoric masses. The two processes are no more inconsistent than are the two processes by one of which trees gather

nutriment from the Earth, and so grow, bud, blossom, bear fruit, and throw out leaves, while by the other they strew upon the Earth leaves, fruit, blossoms, and buds, and in the fulness of time yield even their own substance to the all-nourishing soil. The Earth-born meteorites which return in thousands, year by year, to the Earth from which they sprang, are but as the leaves of a tree compared with the soil from which the tree derives its nourishment, when we compare the total mass of all those meteorites with that of those portions of the mighty cosmical nebula from which the mass of the Earth itself was formed; while this portion in turn compared with the whole nebula is but as the soil nourishing a single tree to that from which a whole forest derives support."

The theory in regard to vast regions of nebulæ in a state of equilibrium was referred to under Comets and would be equally plausible in this connection. And it is also true that many Meteors originate in the breaking up of Comets. In 1846, Biela's Comet divided, and four years later there were 1,500,000 miles intervening. Until 1872 these parts were not seen, but in that year, when the Earth neared that point of intersection in its orbit about the time of the Comet's periodic appearance, streaming lights of millions of Meteors were visible. Thus by the different original velocities of its parts, or by planetary attraction, or some unknown cause, the one Comet had been lengthened into an infinity of Meteors. But just what their origin is, "He knoweth best."

We have waded in deeper than Newton, and yet with him we, of this age, might say, "I have wandered on the shore of Truth's great ocean, and have gathered a few pebbles more beautiful than common; but the vast ocean itself rolls before me undiscovered, unexplored." And of all the ships that cruise from this Solar harbor of ours into the illimitable vastness of that unexplored sea, that sail onward through the aerial universe of endless expanse, the dazzling splendor of the Meteor, and the awful grandeur and infinite sweep of the Comet forcibly recall those words of Young:

"What involution! what extent! what swarms
Of worlds that laugh at earth! immensely great,
Immensely distant from each other's spheres.
What then the wondrous space through which they roll?
At once it quite engulphs all human thought,
'Tis comprehension's absolute defeat."

## NEBULAR HYPOTHESIS.

BY FRANK GRIEST.

SPACE! space! illimitable, infinite, doubly-freezing space! Egyptian darkness! No sky, no earth, no stars, no sun, no moon. A mighty nature-abhorred vacuum. Alone! Space and the Almighty. No sound nor smell, no air, no water, no gravity. No light because no air; no sound for lack of air. No gravity but the law, and nothing upon which that law could operate. The elements were not. Snow, hail, rain, sleet, winds, earthquakes, or moon-quakes, or Jupiter, or Neptune, or Sun-quakes were not. Nothing was; and to that momentous moment—the beginning of all science, of all history—the beginning of everything, except the Creator of all things—let us turn.

* * * *

An hour, a day, a year, an age has passed. We turn again. We feel the rush of wind, the seething of gases. We pass on and on with the rapidity of that thought which takes us to Polaris in the twinkling of an eye; this seething, roaring, rushing, invisible, ethereal matter is everywhere. What but now was space empty, is space filled. How, we know not. Darkness still reigns supreme. Air has brought along its concomitant sound. Gravity may or may not be at work—we do not know—its results are yet invisible. The mighty vacuum is full, and nature has redeemed herself.

Another discovery—this vacuum-filling mass moves according to some law; at some points faster than at others, and always at these same points is it moving faster than at other fixed ones. The whole huge mass is turning on part of itself—that part on which it turns is the hub—the faster motion is nearer the rim. This motion evidently was given at the start when it was poured into this infinite vacuum, like water into a funnel. Another fact—in the places that move slowest the mass is harder to penetrate, the outside parts are bearing down on the hub. Gravity is doing its work.

A change—the intense cold is relieved to some extent. The friction of these currents of air and gas, and the compression near the centre, is raising the temperature steadily yet almost imperceptibly, perhaps a degree in a million years. Darkness also, which has forever existed, is being now slowly yet surely dispelled. As the cold decreases, so does the darkness—twin brothers—heat and light. The one cannot exist independent of the other.

The mass is large and unwieldly; gradually the contraction leaves again a vacuum; the rapidity of revolution is intensified; the power of gravity, in the main mass is not yet sufficient to hold against the enormous centre-fleeing force, and the loose outside part is flung off; the main part contracts steadily, and two masses of vapor, part of the larger semi-fluid, fill the original space. That part thrown off breaks its annular form, and by the exertion of that same centre-seeking gravity force, forms another revolving mass of semi-luminous vapor. The main mass throws off another, and another, and still another ring. It throws off hundreds, thousands, yea, millions of them.

These retain the motion of the parent body with respect to it and also with respect to themselves—except at times when the tangential force threw them too far from the original mass to feel its gravity power.

Now, is there a visible firmament dotted with untold luminosities which "show His handiwork?" The suns are begun—the work is started—the laws are immutable—they will work themselves out on the same plan.

After many days what we call our Sun shrank. The heat intensified; its rapidity of revolution increased; the equatorial regions bulged out; all the loose matter, by reason of its revolution, was collected there; part of it, held by lighter ties, was left behind, still rotating as when of the original mass; and the combined forces which controlled it sent it careering madly and elliptically around the Sun.

When the dimensions of the Sun had decreased to perhaps a little less than the present orbit of Uranus, another equatorial belt was loosed from its parent, another planet was born. So Saturn, Jupiter, and all the others, with untold eon intervals, were launched upon the infinite sea of space.

A disbelief in the perfection of human knowledge led to attempts to bridge the chasms that yawned their black depths of unexplained mysteries in the very face of all thinkers; the then-called infidel endeavor to discover the plan of the Creation had charms for the philosophic and poetic mind. Numerous as these attempts in all probability were during the first decade and a half of Christian centuries, they were evidently unsuccessful, or were strangled at birth by a Church which recognized no knowledge obtained from other sources than itself, but which could reject and denounce the Copernician system, and in the same breath make the dogmatical announcement of Papal infallibility. However, after a long while, thanks to our German friends, thought became less narrowly circumscribed. But, until the latter part of the last century, nothing was known, even in astronomical circles, of that "grandest generalization of the human mind," the Nebular Hypothesis.

The Nebular Hypothesis is an attempt to solve the problem of the creation, not of matter, but of suns *alias* stars, of planets, comets, meteors, etc.; to explain why the Earth and her sister planets revolve around the Sun; why Saturn has rings, and, with Jupiter, Mars and Co., moons. In fact it is an hypothesis, which school children are taught to accept as a proven theory, which is reservedly accepted by many astronomers, and rejected by many more. It is satisfactory and unsatisfactory. It explains some astronomical difficulties to the com-

plete content of all; while others it renders still more complex.

Rev. H. W. Warren, author of "Recreations in Astronomy," thinks he discerns the germ of this theory in the Mosaic record of the Creation, where the Earth is pronounced to have been "without form and void;" but this is so meagre that I cannot believe any one to have been materially assisted by it.

Swedenborg conjectured vaguely in 1743; so also Buffon in 1749. The latter thought that the planets, and consequently their motions, were derived from the collision of a comet with the Sun. The absurdity of this is evident from facts given in a former paper, respecting the density of comets.

The first great step was made by Immanuel Kant, who sought to give it a "philosophical completeness." His theories were based on the observations of Maupertius, a French astronomer, who lived during the first half of the eighteenth century, and they are said to be very similar to those of La Place. He assumed the rotation of the primitive body without accounting for it. He attempted no proof, and his views attracted little, if any, attention until after La Place's demonstration; and even now such valuable works of reference as the American and Chambers' Encyclopedias, together with nine-tenths of the astronomical text-books, do not mention him in this connection.

Kant was a German, of Scotch descent, born in Konigsberg in 1724. He is deservedly considered to stand in the front rank of German philosophers. Although enjoying a world-wide reputation, he never traveled beyond the province in which he was born, and hardly ever beyond his native city. He died in the year 1804.

Contemporary with Kant (born in 1738) was that celebrated astronomical giant, Sir Wm. Herschel an Englishman, who, educated an organist, creditably filled such position in both Bath and Halifax. About 1766, he began the manufacture of optical instruments, and, becoming entranced by the divine music of the spheres, started on that voyage of celestial exploration, whose first immortal milestone was the discovery of the planet Uranus, on the 13th of March, 1781. Soon after this he was made astronomer to the king, George III, who advanced funds with which Herschel made his renowned forty-foot reflecting telescope, the metal speculum of which was four feet in diameter, three inches thick, and weighed 2,000 pounds. With this instrument, the most powerful ever made up to that time, he discovered that binary stars revolve around their common centre of gravity—a fact that will be referred to hereafter; that nebular spots cover about 1-270 of the visible firmament and indicated the position of about 2 500 of these Nebulæ. He divided them into three classes: 1. Clusters of stars; 2. Nebulæ proper; and 3. Nebulous stars. And he advocated the theory that these Nebulæ were formed into stars by rotary motion and the attraction of gravitation. This his son, Sir John Herschel, afterwards called the theory of "sidereal aggregation," and it seemed confirmed by his discovery of the nebulous stars—which were solid and incandescent in the centre, like Sirius and Betelguese, but unlike them, surrounded by a comparatively thin vapory cloud, which emitted light in a less degree than the central star. Herschel was convinced that many of the Nebulæ were irresolvable into star groups, hence his advocacy of the theory.

The French astronomer La Place, of whom it has been said that, "as a physicist, he occupies a position second to that of no mathematical astronomer since Newton," lived contemporaneous with both Kant and Herschel. He became a warm advocate of the Englishman's theory, although never mentioning him in his works, in fact, totally ignoring him by crediting Buffon with being his only predecessor in speculating on this subject. He collected all possible data, advanced the theory that equatorial belts were thrown off from the Sun, broke and formed the planets; and demonstrated it mathematically. In his hands this Hypothesis took very much the shape given by text-books of the present day, which is substantially this:

There once existed in space a great, chaotic nebulous mass, endowed with a kind of whirlpool motion, which gradually condensing, through the mutual attraction of its particles, formed the countless suns distributed through space; the planets were formed by the condensation of rings of matter thrown off by this central mass; the satellites, by the condensation of matter, thrown off by the planets.

Let us pause for a moment in the discussion of this theory, to take a glance at a concomitant subject—*Nebulæ*. This term is derived from a Latin word signifying mist, vapor, or cloud, and is a first cousin of the familiar Latin word *nubes*, "cloud." The Nebulæ are those cloud-like masses of luminous matter which can be seen at certain points in the heavens on any clear night. A few of these, for example, those in Libra, Hercules, the Twins, and the celebrated Fish-mouth nebula near the sword handle in Orion, are visible to the naked eye.

It has already been mentioned that the first astronomer who sufficiently studied these bodies to make any classification of them, was Sir. Wm. Herschel. He thought he had discovered Nebulæ in a sufficient number of intermediate stages, to draw the inference that stars were formed of them by condensation; but the announcement that Lord Rosse's telescope, erected in 1844, resolved into star clusters many of those supposed true Nebulæ, seemed to take the wind out of both Herschel's and La Place's sails, for the deduction seemed proper, that all that was necessary to resolve any of them, was a sufficiently powerful telescope. After this iconoclastic demolition of all preconceived ideas, no text-books, for perhaps more than a dozen years had the temerity to mention the Nebular Hypothesis. Prof. Mitchell, in his "Astronomy of the Bible," written during this period, speaks of it as a theory "which has of late years become somewhat noted, because of its *abandonment* by certain prominent individuals, who had previously been its ardent advocates." The disciples of our Hypothesis, like the proverbial rats, left their sinking craft, but Herbert Spencer with might and main worked at the pumps, keeping the hulk afloat, until, when in the autumn of 1864 Mr. Huggins with a spectroscopically-armed telescope, proved beyond cavil that the planetary Nebula in Draco was a mass of glowing gas, Lord Rosse's objections were swept away like leaves before the autumn wind, and "Richard was himself again." The Nebular Hypothesis regained its pristine position.

These Nebulæ are most abundant where there are the fewest stars. When Herschel during his examination of the heavens saw but few stars, he used frequently to say to his assistant, "Prepare to write; the Nebulæ are coming." This fact may be impressed by the following from Prof. Newcomb: "Imagine a belt thirty degrees wide extending around the heavens, including the Milky Way, and reaching fifteen degrees on each side of the central circle of the Milky Way. This belt will include nearly one-fourth of the surface of the celestial sphere, and if the stars or Nebulæ were equally distributed, nearly one-fourth of them would be found in the belt. Instead, however, of one-fourth, we find nine-tenths of the star clusters, but only one-tenth of the Nebulæ." The light received in a moderate-sized telescope from some of the more distant of these is very dim. It has been estimated that that of a sperm candle one-fourth of a mile distant would be from 1,500 to 20,000 times as brilliant.

Whether these bodies belong to our own stellar system or not is a mooted question, arguments having been adduced on both sides. But I believe that the preponderence of evidence as well as the majority of votes—polling both men and women, who are entitled by virtue of sufficient knowledge and ripe judgment, to astronomical suffrage—favors the belief that they do.

La Place believed the expanded nebulous matter to be luminous and heated to an intense degree; he thought that perhaps the Sun had previously existed, and had in some unknown way become so heated that it more than filled our whole system. He does not explain how the initial motion was obtained. Helmholtz thought that the matter was not at all heated, and speaks

of the rotary motion as originally slow, the "existence of which must be assumed." Mary Somerville, Lardner, Arago, Kirkwood, Nichol, and Mitchell, all agree in stating that they know not the cause of the original motion.

That the rotary motion of the Sun and planets, the orbital motion of the latter, and the motion of Saturn's rings is from west to east; that the orbits of all planets are nearly circular and cometary orbits so diverse, and that planets move nearly in the plane of the Sun's equator, Kirkwood says, are all facts which cannot be accounted for by the law of gravitation. Mitchell holds the same views.

Mr. Jacob Ennis, of this State, in an exhaustive treatise on the power of gravity, published by D. Appleton & Co., in 1866, advances some original ideas on this subject, which are quite at variance with any I have elsewhere seen. He attempts to prove that the initial rotary motion to the nebulous mass, was given by gravity; that gravity threw off the rings; and that gravity gave all the planets and their satellites their motion from west to east. But Mr. Ennis in the same volume proves that there can be no planet between the Sun and Mercury, whereas recent observations seem to show that we have Vulcan; and he also proves that of Mars, the Earth, Venus, and Mercury, the Earth is the only planet that can have a moon. In the light of Prof. Hall's comparatively recent discovery of the moons of Mars this proof is entitled to little consideration.

Now let us look at those facts which seem to substantiate the Nebular Hypothesis—those other than the nebular facts to which I have already reverted.

1. All known planets move in the same direction about the Sun. This fact first led Kant to investigate the subject, for he argued that it could not be accounted for by chance.

2. All known moons, but one, move in that same direction about their planets.

3. These motions are all the same as that of the Sun on its axis.

4. All known planets except the asteroids, move very nearly in the plane of the Sun's equator.

5. The rings of Saturn. Mitchell says that, "Saturn's rings were left to show us how the worlds were made." It is contended by others, however, that these rings which are now considered to be vast aggregations of meteors traveling in a circum-Saturnial orbit, were formed from the fragments of former satellites, which were disrupted by the attractive power of Saturn.

6. The experiment of placing a drop of oil in water and giving it a rotary motion has been successfully made; it flattened at the poles and eventually threw off from its equator minute rings.

Lockyer says: "It may take years to prove or disprove this Hypothesis; but the tendency of recent observations is to show its correctness."

But with all the weight of argument which has been brought to the advocacy of this theory, and all the ingenious explanations of supposed contradictory evidence, there remain certain unexplained facts, which, if unexplainable, will surely undermine this noble structure of La Place.

1. One moon of Uranus revolves in the *opposite* direction.

2. One of Mars' moons has a velocity three times as great as Mars itself.

Now, it is an established fact in physics, that as the volume of a revolving body contracts, the velocity increases. According to this, the velocity of the inner moon of Mars *should* be the greater, for it was thrown off when Mars was revolving more rapidly, whereas it it less. But Mars also *should* make an axial revolution in less time than either of its moons revolves about it; whereas the inner moon makes an orbital revolution in one-third of the time taken by the planet itself for its axial revolution. Prof. Kirkwood, speaking of this, says: "Unless some explanation can be given, the shorter period of the inner satellite will, doubtless, be regarded as a conclusive argument against the Nebular Hypothesis." That great soldier-astronomer, Gen. O. M. Mitchell, who died of yellow fever at Beaufort, South Carolina, in October, 1862, knew nothing of Mars' moons, but, defending the theory in one of his latest works, he said: "Suppose we had discovered that it required more time for Saturn or Jupiter to rotate on their axis than for their nearest moon to revolve round them in its orbit; this would have falsified the theory." The only explanation I have yet heard is that of collision with some comet.

3. The planet Vulcan is said to make a revolution in its orbit in less time than the Sun makes an axial revolution.

4. A star now in Canes Venatici has a velocity greater than could be given by the combined attraction of all known matter in the universe.

5. In 1876, a new star blazed out with great brilliancy in the Swan. According to this theory it should have taken untold centuries to do this and a like time to lose its intense light. It was closely observed. In a short time it changed from a star into a nebula, assigning no reason for thus neglecting to comply with the provisions of our Hypothesis.

6. In some of the Nebulæ there are vast gaps in the middle where they should be most dense.

7. The results of quite recent spectroscopic investigations show that "the gases so examined are not only of nearly equal density, but that they exit in a low state of tension; and this fact," says a recent writer in the *Popular Science Monthly*, "is fatal to the Nebular theory."

Burritt, the author of the most popular astronomy in this country, in an article on Nebulæ in his last edition, speaking of this Hypothesis, says: "But the little we know of the physical constitution of these sidereal masses, is insufficient to warrant such a conclusion."

The author of an astronomical catechism, Hiram Mattison by name, puts the following: "Is this theory correct, or even probable?" His laconic answer, "It is not," he backs up with such contorted biblical arguments as Agassiz, one of the most devout men of his day, would have laughed to scorn.

Prof. Daniel Vaughn is not alone in his advocacy of the theory that planets are formed by the aggregation of meteoric bodies and that the next formed planet will be beyond the orbit of Neptune. Even now many astronomers have noted irregularities in the motion of that planet and are searching for another to double the breadth of the Sun's domain.

Proctor teaches that the Solar System had its origin in meteoric and cometic aggregation, and that in the gaseous Nebulæ we probably see vast systems of comets traveling in extensive orbits around nuclear stars.

The theory of a resisting medium in space has been urged as the only way by which to account for the short distances that some satellites are from their primaries, it having with apparent certainty been proved that a nebulous ring could not form into a solid mass in such close proximity to a planet. This resisting medium gradually reduces the satellitic orbit. The outcome of this theory is that all satellites will, at some time, coalesce with their primaries; that all planets will coalesce with theirs, and that the heat thereby caused will again expand the Sun to a mighty nebulous mass, and the world-making process will be begun anew. This may account for that phenomenal star which appeared some time since in the Northern Cross and afterwards became a nebula.

From what has been said it will be seen that this theory like multitudes of others, notably those accounting for tides, earthquakes, volcanoes, the aurora borealis, springs, primordial germs, etc., rests on the insecure foundation of human speculation. It has not and probably cannot be conclusively proven. The problem of the Creation has eluded the grasp of our mightiest intellects; it *has been* a fruitful theme for controversy for centuries, and *will be* for generations upon generations yet to come. As a question of discussion and speculation it will probably outlive the most protracted government on the face of our globe, and may remain an unsolved mystery

Till the Sun grows cold,
And the stars are old,
And the leaves of the Judgment Book unfold!

[These valuable Papers concluded in January or February No. of *Journal*.]

## THE GOLDEN RULE.

THE INWARD VOICE.

SONG. The gold - en rule, the gold - en rule, Oh, that's the law for me; Were this the law for
Were this the rule, in har - mo - ny Our lives would pass a - way; And none would suf - fer,
HYMN. I hear it of - ten in the dark, I hear it in the light; Where is the voice that
SONG. all the world, How hap - py we should be. Cho. The gold - en rule, the gold - en rule,
none be poor, And none their trust be - tray. The gold - en rule, the gold - en rule,
1. calls to me, With such a qui - et might? Cho. O sweet surprise of in - ner skies,
SONG. Oh, that's the law for me; To do to oth - ers as I would That they should do to me.
1. Those voices still and strong, That fill the spir - it's si - lences With music and with song.

2. They send me challenges to right,
And loud rebuke my ill;
They ring my bells of victory,
They breathe my "Peace, be still."—*Cho.*

3. O God within, so near to me
That every thought is plain,
Be judge, be friend, be Father still,
And in Thy heaven reign.—*Cho.*

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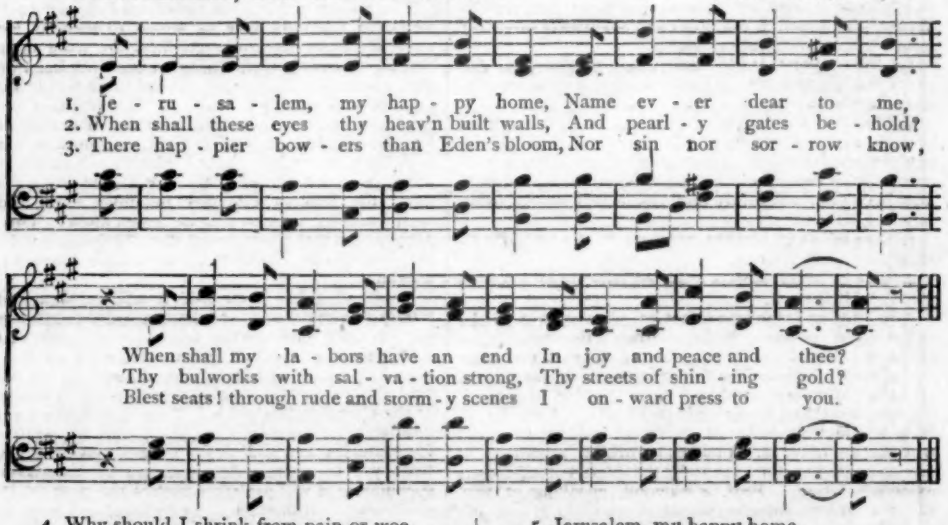
## JERUSALEM, MY HAPPY HOME.

LATIN HYMN, A. D. 900.


1. Je - ru - sa - lem, my hap - py home, Name ev - er dear to me,
2. When shall these eyes thy heav'n built walls, And pearl - y gates be - hold?
3. There hap - pier bow - ers than Eden's bloom, Nor sin nor sor - row know,
When shall my la - bors have an end In joy and peace and thee?
Thy bulworks with sal - va - tion strong, Thy streets of shin - ing gold?
Blest seats! through rude and storm - y scenes I on - ward press to you.

4. Why should I shrink from pain or woe,
Or feel at death dismay?
I've Canaan's goodly land in view,
And realms of endless day.

5. Jerusalem, my happy home,
My soul still pants for thee:
Then shall my labors have an end,
When I thy joys shall see.